

TUBE MANUAL

EIMAC division of varian
SAN CARLOS, CALIFORNIA

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

25 April 1975

TO EIMAC TUBE MANUAL HOLDERS

The enclosed data sheets are to be inserted in the appropriate section of your EIMAC Tube Manuals. Please update your Table of Contents and Index to reflect these additions and revisions. Our next mailing will include updated material for your General Section.

VOLUME I	INSERT	REMOVE
Triodes		
3CX1000A7/8283	3/25/75	11/1/68
8963	4/01/75	
VOLUME II		
Other Products		
SK510	3/15/75	6/15/71
SK600A/SK610A	11/01/74	6/15/71

Also enclosed is EIMAC's new Quick Reference Catalog 175. This supersedes Quick Reference Catalog 171.

William I. Orr
Manager, Technical Data

WIO/ad

Enclosures

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

15 January 1975

TO ALL EIMAC TUBE MANUAL HOLDERS

The following data sheets are to be inserted in the appropriate section of your EIMAC manuals, volumes I and II. Please use your Tabel of Contents as a guide.

	INSERT	REMOVE
VOLUME I		
General		
Table of Contents	1/15/75	5/01/74
Index	1/15/75	5/01/74
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet	1/15/75	5/01/74
Varian/EIMAC Electron Tube and Device Group Sales Office list	1/15/75	5/01/74
Diodes - Rectifiers		
2-240A	---	10/21/59
Triodes		
3-400Z/8163	8/15/74	5/01/68
3-1000Z/8164	8/15/74	3/15/67
3CW20,000H7	5/15/74	---
3CW25,000A3	---	3/01/67
3CX400U7/8961	8/01/74	---

	INSERT	REMOVE
VOLUME II		
General		
Table of Contents	1/15/75	5/01/74
Index	1/15/75	5/01/74
Tetrodes		
4CV75,000A	---	6/15/71
4CX250B/7203 & 4CX250FG/8621	8/01/74	---
4CX250B/7203 & 4CX250F/7204	---	5/15/73
4CX250BC/8957	1/01/74	---
4W20,000A/8173	---	4/15/74
4X150A/7034 & 7609	8/01/74	---
4X150A/7034 & 4X150D/7035	---	5/04/70
8954	6/01/74	---
8959	11/01/74	---
Other Products		
SK-606, SK-626, SK-636B, SK-646	11/01/74	8/15/66

William I. Orr
Manager, Technical Data

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
General				
Table of Contents		12-18-63	Table of Contents	11-18-63
Tetrodes-Pentodes				
4CW2000A	11-1-63			
4CW10,000A	4-15-63			
Power Klystrons				
WL-150	11-1-63			
Other Products				
SK-1300	5-9-63			

varian

1 May 1978

TO EIMAC TUBE MANUAL HOLDERS

The enclosed new or revised data sheets along with an updated Table of Contents, Index, EIMAC/JEDEC Cross Reference List, Sales Office Locations and Franchised Distributor List are to be inserted in the appropriate section of your EIMAC Tube Manual, Volumes I & II. Please use your Table of Contents as a guide. The data sheets to be removed with no replacements are discontinued tube types.

VOLUME I	INSERT	REMOVE
General		
Table of Contents	4/15/78	10/01/76
Index	4/15/78	9/01/75
EIMAC/JEDEC Cross Reference	4/15/78	9/01/75
Sales Office Locations	3/15/78	2/01/76
Franchised Distributor List	3/15/78	1974
Diodes & Rectifiers		
2-2000A	---	7/01/52
575A & 673	---	4/01/67
869B & 869BL	---	3/16/64
6894 & 6895	---	3/16/64
8020	---	6/01/67
Planar Triodes		
8755	3/31/78	6/01/71
8892	---	9/01/70
8893	---	6/01/70
8911	---	2/01/71
8912	---	2/01/71
Triodes		
3-400Z/8163	6/01/77	8/15/74
3-500Z	6/01/77	11/01/73
3CV1500A7	---	6/15/71
3CX1500A7/8877	5/15/77	7/01/75
3W5000F3/8243	---	10/20/61
35TG	---	6/01/67
75TH	---	12/15/65
75TL	---	4/01/67
152TH	---	11/25/52
152TL	---	4/01/67

Triodes (continued)	INSERT	REMOVE
1000T	---	12/15/65
1500T	---	5/05/70
2000T	---	10/15/50
6696A	---	10/15/64
6697A	---	10/15/64
7480	---	11/01/68
8873/8874/8875	1/01/77	6/03/73
8963	---	8/01/75

VOLUME II

General
Same as Volume I

Tetrodes		
4CV20,000A	---	6/01/68
8876	---	6/15/71
X2159	5/01/77	7/01/73

Other Products		
CV-850	3/01/78	---
SK-300A	3/15/78	4/15/69

William I. Orr

William I. Orr, Manager
Technical Data

WIO/a

Enclosures

VOL. II

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
GENERAL				
Table of Contents		1-15-65	Table of Contents	9-30-65
POWER KLYSTRONS				
5K70SG	10-15-65			
5KM300SI	11-1-65			
X-3034	11-1-65			
X-3054	7-15-65			

VOL.1

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
General				
Table of Contents		2-28-65	Table of Contents	1-31-65
Triodes				
3CX2500A3	9-1-64			
3W5000A1/8240		8-15-64	3W5000A1/8240	2-18-63
Other Products				
EO-101 Detonator				
EO-201 Squib	11-15-64			
SK-300A	11-1-64		SK-300	1-1-63
ADDITIONS				
Other Products				
Ceramic VacCap* Vacuum Capacitors	2-15-65			
Triodes				
5867A	11-15-64			

Additions will appear on our next Table of Contents

* Trademark

Eimac®

EITEL-McCULLOUGH, INC.

TABLE OF CONTENTS

VOL. I

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	5-15-64
Eimac and EIA Tube Number Cross Reference Sheet	February '64
Power Frequency Chart for Power Grid	———

DIODES – RECTIFIERS – PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	8-1-64
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	12-1-63
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	4-9-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CW25,000A3	11-1-63
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX2500A3	9-1-64
3CX2500 F3	9-1-64
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	11-1-63

TRIODES (Continued)	Effective Date
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61
3X2500F3/8251	6-30-64
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	8-15-64
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CS100L	4-20-64
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63

TETRODES–PENTODES (Continued)	Effective Date
4CX250R	6-16-61
4CX300A/8167	12-1-63
4CX300Y	11-1-63
4CX350A/8321 & 4CX350F/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	11-4-63
4CX1000K/8352	1-1-64
4CX3000A/8169	3-1-63
4CX5000A/8170	10-1-64
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	6-15-60
4X150G/8172	8-15-63
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52

OTHER PRODUCTS	
VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
CS-8301 Laser Tube Assembly	10-5-64
EO-101 Detonator EO-201 Squib	11-15-64
SK-300A	11-1-64
SK-306, SK-316	5-21-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	8-15-64
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890, SK-806	4-9-64
SK-900, SK-906	6-1-60
SK-1300	5-9-63
SK-1306, SK-1406	5-17-63
SK-1400A, SK-1470A	5-9-63

*Not recommended for New Equipment Design.

Eimac® NEWSLETTER — Power Grid Tube Division

February 12, 1965

Dear Friend,

Are you in the market for a really reliable vacuum capacitor?

Here's NEWS you can't afford to miss.

Eimac is introducing a broad new line of fixed and variable vacuum capacitors featuring higher rf rms current ratings and longer life than any other capacitor available... and at competitive prices.

Our new VacCap* vacuum capacitors employ a unique patented design which meets higher power and current rating requirements found in today's advanced transmitters. These all-ceramic-and-copper capacitors are available in any value of capacitance up to 1500 picofarads at any voltage from 5 to 50 kV, with current ratings up to 225 amperes without cooling.

Enclosed are descriptions and data sheets on our new VacCap* fixed vacuum capacitors. Next month we will provide you with more information on our new variable capacitor design.

Eimac VacCap* vacuum capacitors have been thoroughly evaluated in our high power rf test amplifier; current and voltage ratings are quite conservative. We have the most reliable vacuum capacitor on the market, and we're proud of it. We are eager to work with you to provide whatever applications assistance your design requirements may demand.

Sincerely,

Jack Quinn

JACK QUINN
Product Manager
Power Grid Tube Division

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

VOL. I

Type of Information	New	Revision	Remove Sheet	Dated
General				
Table of Contents		1-31-65	Table of Contents	8-31-64
Diodes-Rectifiers-Pulse Modulators				
250R		8-1-64	250R	7-1-52
Triodes				
3CX2500F3	9-1-64			
3CX10,000A1/8158		8-14-64	3CX10,000A1/8158	1-1-63
3CX10,000A3/8159		8-15-64	3CX10,000A3/8159	10-20-64
304TL		8-15-64	304TL	7-21-58
6696A	10-15-64			
6697A	10-15-64			
7211	9-1-64			
7480	10-15-64			
Tetrodes-Pentodes				
4CX5000A/8170		10-1-64	4CX5000A/8170	2-15-63
7580 - Please remove from Catalog				
Other Products				
CS-8301 Laser Tube Assembly	10-5-64			
SK-506, SK-516		8-15-64	SK-506, SK-516	5-21-63

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

June 1, 1967

TO ALL EIMAC TUBE MANUAL HOLDERS -- VOLUME I

The following Data Sheets are to be inserted in the appropriate section of your tube manual in numerical order by the tube type number. You may wish to use your Table of Contents as a guide.

	INSERT	REMOVE
GENERAL Section		
Table of Contents	(6- 1-67)	(5- 1-67)
Tube Type Numbering System	(2- 1-67)	(4- 3-58)
DIODES-RECTIFIERS-PULSE MODULATORS		
2X3000F	(3- 1-67)	(6- 1-63)
TRIODES		
3-1000Z/8164	(3-15-67)	(11-16-64)
3CX2500A3/8161	(3- 1-67)	(12-15-64)
75TL	(4- 1-67)	(1- 2-52)
100TH	(4- 1-67)	(4- 1-49)
152TL	(4- 1-67)	(1- 1-44)
304TH	(4- 1-67)	(4- 1-67)
TETRODES-PENTODES		
4CX1500B	(6- 1-67)*	(4- 1-67)
4CX3000A/8169	(5- 1-67)	(9-16-65)
4CX5000A/8170	(5- 1-67)	(10- 1-64)
5CX1500A	(4-15-67)	(2-15-65)
OTHER PRODUCTS		
SK-711A	(4-15-67)	(5- 9-63)

* Data Sheet revised to change 900 amp to .900 amp DC Plate Current listed under RF Linear Amplifier.

For additional Data Sheets or information about your EIMAC Tube Manual, please contact the undersigned.

Very truly yours,

Robert Landon

Robert O. Landon, Manager
Public Relations & Technical Data

Encl. (14)

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

May 1, 1967

TO ALL EIMAC TUBE MANUAL HOLDERS -- VOLUME I

The following data sheets are to be inserted in the appropriate section of your tube manual in numerical order by tube type number. You may wish to use your Table of Contents as a guide.

	INSERT	REMOVE
GENERAL Section		
Table of Contents	(5- 1-67)	(10-15-66)
EIMAC & EIA Power Grid Tube No. Cross Reference Sheet	(1967)	(1966)
DIODES-RECTIFIERS-PULSE MODULATORS		
4PR60B/8252	(11- 1-66)	(2-15-62)
TRIODES		
3-400Z/8163	(3-15-67)	(6-15-66)
3CV30,000A3	(3- 1-67)	(10- 1-63)
3CW25,000A3	(3- 1-67)	(11- 1-63)
3CX2500F3	(3- 1-67)	(12-15-65)
TETRODES-PENTODES		
4CX1500B	(4- 1-67)	(1-15-66)
OTHER PRODUCTS		
100 IG Ionization Gauge	OBSOLETE	(6-15-53)
SK-500	(3-15-67)	(3- 1-56)
SK-620, SK-620A	(3-15-67)	(1-15-63)
SK-630, SK-630A	(3-15-67)	(1-18-63)
SK-700, SK-710	(10-15-66)	(1-20-58)
SK-860, SK-870	(3-15-67)	(5- 9-63)
SK-1400A, SK-1470A	(10-15-66)	(5- 9-63)

For additional data sheets or information about your EIMAC Tube Manual, please contact the undersigned.

Very truly yours,

Robert Landon

Robert O. Landon, Manager
Public Relations & Technical Data

Encl. (15)

VOLUME I

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
GENERAL				
Table of Contents		4-15-66	Table of Contents	12-31-65
DIODES-RECTIFIERS-PULSE MODULATORS				
2-150D		12-15-65	2-150D	7-1-52
TRIODES				
3CX2500F3		12-15-65	3CX2500F3	9-1-64
3CX2500H3	3-15-66			
25T		12-15-65	25T	2-1-54
304TL		12-15-65	304TL	8-15-64
750TL		12-15-65	750TL	12-11-57
TETRODES-PENTODES				
4-125A/4D21		12-15-65	4-125A/4D21	6-1-60
4-400A/8438		9-1-65	4-400A/8438	2-15-63
4CX1500B	1-15-66			
OTHER PRODUCTS				
HR Heat Dissipating Connectors		12-1-65	HR Heat Dissipating Connectors	12-12-57
X6065	3-15-66			
SK-640		2-15-66	SK-640	3-31-61
SK-650 & SK-655		1-15-66	SK-650 & SK-655	3-31-61

VOLUME 1

TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
GENERAL				
EIMAC Field Reps			EIMAC Field Reps	6-1-65
Distributors		6-15-66	Distributors	5-15-65
DIODES-RECTIFIERS-PULSE MODULATORS				
2-450A		3-1-66	2-450A	11-3-59
TRIODES				
3CW5000H3	4-1-66			
3CW10,000H3	4-1-66			
3CX5000H3	4-1-66			
3CX10,000H3	3-15-66			
3CX15,000H3	4-1-66			
			3X2500A3/8161	11-20-61
			3X2500F3/8251	6-30-64
			3X3000A1/8238	2-18-63
			3X3000A7	5-20-63
			3X3000F1/8239	2-18-63
			3X3000F7/8162	5-5-61
			CS-8301 Laser Tube Assy.	10-5-64
			EO-101/EO-102	11-15-64
			X6004 Ultraprobe	6-1-65
			X6006 Docking Light	10-1-65
			X6007 Nuclear Battery	9-15-65
			X6065 Feedthrough	3-15-66

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

TO ALL EIMAC TUBE MANUAL HOLDERS

The following data sheets are to be inserted in the appropriate section of your EIMAC manuals, volumes I and II. Please use your Table of Contents as a guide.

	INSERT	REMOVE
VOLUME I		
GENERAL		
Table of Contents	5-1-74	7-1-73
Index	5-1-74	7-1-73
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet	5-1-74	7-1-73
Varian/EIMAC Electron Tube and Device Group Sales Office	5-1-74	7-1-73
PLANAR TRIODES		
8933	11-15-72	--
TRIODES		
3-500Z	11-1-73	2-1-71
3CW5000A3/8242 and 3CW5000F3/8243	1-11-74	6-1-67
3CX1500A7/8877	8-1-73	5-15-71
3CX20,000A7	7-1-73	--
8873/8874/8875	6-3-73	6-1-71
8933	--	12-14-72
8938	5-15-73	--

	INSERT	REMOVE
VOLUME II		
GENERAL		
Table of Contents	5-1-74	7-1-73
Index	5-1-74	7-1-73
TETRODES		
4CW800B/F	11-1-73	3-1-68
4CX15,000A/8281	12-15-73	5-15-71
4W300B/8249	11-1-73	5-1-70
4X150G/8172	10-15-73	6-15-66
8930	12-1-73	--
X2159	7-1-73	--
OTHER PRODUCTS		
SK-406,SK-416,SK-426	12-1-73	6-1-67
SK-410	12-1-73	11-15-62

William I Orr

William I. Orr
Manager, Technical Data

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

TO ALL EIMAC TUBE MANUAL HOLDERS:

The EIMAC tube manual is being divided into two volumes. Volume I will contain sections entitled "GENERAL, DIODES-RECTIFIERS, PLANAR TRIODES and TRIODES". Volume II will contain sections entitled "GENERAL, TETRODES, PENTODES, PULSE MODULATORS and OTHER PRODUCTS".

After you have divided your present manual into two volumes as indicated above, using the enclosed dividers, the following additions and deletions are to be made using the Table of Contents as a guide.

	INSERT	REMOVE
VOLUME I		
GENERAL		
Tube Type Numbering System	6-1-73	2-1-67
Table of Contents	7-1-73	5-15-72
Index	7-1-73	
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet	7-1-73	7-1-71
Power Grid Selection Guide	7-1-73	
Varian/EIMAC Electron Tube and Device Group Sales Offices	7-1-73	
PLANAR TRIODES		
7855AL/7855KAL	3-1-72	
TRIODES		
8160/3CX10,000A7	2-1-73	6-1-67
VOLUME II		
GENERAL		
Table of Contents	7-1-73	
Index	7-1-73	
TETRODES		
8072W/8121W/8122W (discontinued)		7-30-71
8828W (discontinued)		2-15-72
4CV250,000A	3-1-72	5-1-68
PENTODES		
8295A	1-15-73	2-1-70

William I. Orr
Manager, Technical Data

WIO/g
7:1973

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

July 15, 1967

TO ALL EIMAC TUBE MANUAL HOLDERS -- VOLUME I

The following Data Sheets are to be inserted in the appropriate section of your tube manual in numerical order by the tube type number. You may wish to use your Table of Contents as a guide.

	INSERT	REMOVE
GENERAL Section		
Table of Contents	(7-15-67)	(6- 1-67)
Distributors	(7- 1-67)	(5-15-66)
DIODES-RECTIFIERS-PULSE MODULATORS		
575A & 673	(4- 1-67)	(3-16-64)
8020 (100R)	(6- 1-67)	(2- 1-52)
TRIODES		
3CPN10A5/7815	(4-15-67)	(1- 1-63)
3CPX100A5/7815R	(4-15-67)	(1- 1-63)
3CW5000A3	(6- 1-67)*	
3CX3000A7	(5-15-67)*	
3CX10,000A7/8160	(6- 1-67)	(11- 1-63)
3W5000A3/8242		(6- 1-64)**
35TG	(6- 1-67)	(5- 1-62)
304TL	(6- 1-67)	(12-15-65)
7211	(6- 1-67)	(9- 1-64)
TETRODES-PENTODES		
4-125A	(6- 1-67)	(12-15-65)
4CX125C,F	(6- 1-67)	(1- 1-63)
4CX600A		(5- 7-63)**
4CX1000A/8168	(6- 1-67)	(6-15-66)
OTHER PRODUCTS		
SK-406,SK-416,SK-426	(6- 1-67)	(11- 1-65)
SK-890B,SK-806	(6- 1-67)	(4- 9-64)

For additional Data Sheets or information about your EIMAC Tube Manual, please contact the undersigned.

Very truly yours,

Robert Landon

Robert O. Landon, Manager
Public Relations & Technical Data

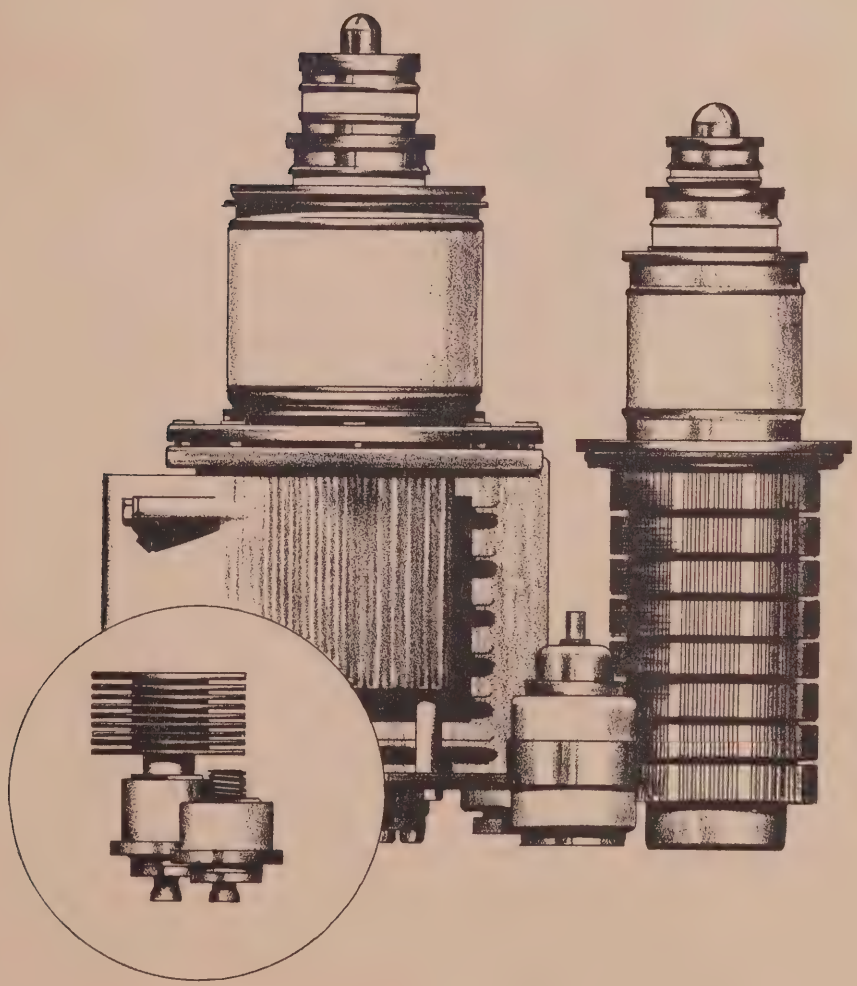
* New
** Obsolete

Enc. (17)

RAYTHEON

MACHLETT
Electron Tubes

BRYLE BRUNETTE
ALLIED ELECTRONICS
3701 W. Fond Du Lac Ave.
Milwaukee, Wisconsin 53216
414-444-2840



INDEX BY TUBE TYPE

Type	Page
ML-XRT1	7
ML-DP15	5
ML-LPT17	5
ML-2C39A	5
ML-2C39WA	5
ML-2C41	5
ML-102A	7
ML-141	7
ML-142	7
ML-342A	1
ML-342AA	1
ML-356	1
ML-880	1
ML-889RA	1
ML-891	1
ML-891R	1
ML-892	1
ML-892R	1
ML-893A	1
ML-893AR	1
ML-5530	1
ML-5530H	1
ML-5531	1
ML-5541	1
ML-5575/100	7
ML-5576/200	7
ML-5604	1
ML-5606	1
ML-5619	1
ML-5658	1
ML-5666	1
ML-5667	2
ML-5668	2
ML-5669	2
ML-5681	2
ML-5682	2
ML-6256	2
ML-6257	2
ML-6258	2
ML-6420	2
ML-6421	2
ML-6421F	2
ML-6422	2
ML-6423	2
ML-6423F	2
ML-6424	2
ML-6425	2
ML-6425F	2
ML-6426	2
ML-6427	2
ML-6442	5
ML-6544	4
ML-6576	2
ML-6696	3
ML-6697	3
ML-6771	5
ML-6908	7
ML-7002	4
ML-7003	4
ML-7007	3,5
ML-7209	5
ML-7210	5
ML-7211	5
ML-7248	4
ML-7249	4
ML-7289/3CX100A5	5
ML-7479A	3
ML-7480A	3
ML-7482	3
ML-7560	3,4
ML-7668	4
ML-7698	5
ML-7715	4
ML-7815/3CPN10A5	6
ML-7845	4
ML-7855	6
ML-8038	4
ML-8040	4
ML-8041	4
ML-8094/199	7
ML-8170/4CX5000A	3
ML-8171/4CX10000D	3
ML-8224	7
ML-8281/4CX15000D	3
ML-8317	3,4
ML-8403	6
ML-8495	5
ML-8533	6
ML-8534	6
ML-8535	6
ML-8536	6
ML-8537	6
ML-8538	6
ML-8539	6
ML-8545	3
ML-8546	4,5
ML-8547	3,4
ML-8548	5
ML-8618	3,5
ML-8629	6
ML-8630	6
ML-8631	6
ML-8661/4CW10000A	4
ML-8741	6

TRIODES

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings	FILAMENT Voltage Volts	FILAMENT Current Amps.	Mu	Class of Service	MAXIMUM RATINGS PLATE Voltage Vdc	PLATE Current Adc	GRID Voltage Vdc	GRID Current Adc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-342A Water Cooled	#3	Oscillator, Modulator, Amplifier	10- 30 kW	4 mc sec.	20.0	67	40	C-T	20000	2.5	—	—	—	25000	ML-342A Water Cooled
ML-342AA Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	10- 30 kW	4 mc sec.	20.0	67	40	C-T	20000	2.5	—	—	—	5000	ML-342AA Forced-Air-Cooled
ML-356 Water Cooled	#2C	Oscillator, Modulator, Amplifier	30- 50 kW	25 mc sec.	7.5	170	20	C-T	12500	6	- 2000	0.80	60000	22500	ML-356 Water Cooled
ML-880 Water Cooled	#2B	Oscillator, Modulator, Amplifier	24- 40 kW	25 mc sec.	12.6	315	20	C-T	10500	6.0	- 1200	0.80	60000	20000	ML-880 Water Cooled
ML-889RA Forced-Air-Cooled	#2A	Oscillator, Modulator, Amplifier	5- 10 kW	40 mc sec.	11.0	120	21	C-T	8500	2.0	- 1000	0.25	16000	5000	ML-889RA Forced-Air-Cooled
ML-891 Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc sec.	22.0	60	8.5	C-T	12000	2.0	- 3000	0.15	18000	6000	ML-891 Water Cooled
ML-891R Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc sec.	22.0	60	8.5	C-T	10000	2.0	– 3000	0.15	15000	4000	ML-891R Forced-Air-Cooled
ML-892 Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc sec.	22.0	60	50	C-T	15000	2.0	- 3000	0.40	30000	10000	ML-892 Water Cooled
ML-892R Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc sec.	22.0	60	50	C-T	12500	2.0	3000	0.40	18000	4000	ML-892R Forced-Air-Cooled
ML-893A Water Cooled	#3	Oscillator, Modulator, Amplifier	30- 50 kW	5 mc sec.	20.0	183	34.5	C-T	20000	4.0	- 3000	0.40	70000	20000	ML-893A Water Cooled
ML-893AR Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	30- 50 kW	5 mc sec.	20.0	183	34.5	C-T	20000	4.0	- 3000	0.40	70000	20000	ML-893AR Forced-Air-Cooled
ML-5530 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	4- 6.7 kW	110 mc sec.	5.0	55	26	C-T	5000	1.75	1000	0.20	8750	4000	ML-5530 Forced-Air-Cooled
ML-5530H Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	6.7- 7.2 kW	30 mc sec.	5.0	55	26	C-T	8500	1.75	1000	0.40	10000	4000	ML-5530H Forced-Air-Cooled
ML-5531 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	14- 20 kW	30 mc sec.	6.3	92	24	C-T	10500	3.75	– 1500	0.6	30000	10000	ML-5531 Forced-Air-Cooled
ML-5541 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	6-11.5 kW	110 mc sec	7.5	57	26	C-T	8500	2.75	- 1500	0.30	23000	10000	ML-5541 Forced-Air-Cooled
ML-5604 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	9- 15 kW	25 mc sec	11.0	176	20	C-T	12500	3.0	2000	0.45	32500	10000	ML-5604 Forced-Air-Cooled
ML-5606 Water Cooled	#2A	Oscillator, Modulator, Amplifier	7- 15 kW	1.6 mc sec	22.0	60	50	C-T	14000	2.0	- 1600	0.40	25000	10000	ML-5606 Water Cooled
ML-5619 Water Cooled	#2B	Oscillator, Modulator, Amplifier	9- 22 kW	25 mc sec.	11.0	176	20	C-T	12500	3.0	- 2000	0.45	32500	20000	ML-5619 Water Cooled
ML-5658 Water Cooled	#2B	Oscillator, Modulator, Amplifier	17- 38 kW	15 mc sec	12 0	310	20	C-T	12500	6 0	1600	0 80	60000	20000	ML-5658 Water Cooled
ML-5666 Water Cooled	#2B	Oscillator, Modulator, Amplifier	6- 12 kW	22.5 mc sec.	11.0	120	21	C-T	10000	2.0	1500	0.35	20000	12500	ML-5666 Water Cooled

TRIODES — continued

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings	FILAMENT Voltage Volts	FILAMENT Current Amps.	Mu	Class of Service	MAXIMUM RATINGS PLATE Voltage Vdc	PLATE Current Adc	GRID Voltage Vdc	GRID Current Adc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-5667 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	6- 12 kW	22.5 mc sec.	11.0	120	21	C-T	10000	2.0	1500	0.35	20000	7500	ML-5667 Forced-Air-Cooled
ML-5668 Water Cooled	#2B	Oscillator, Modulator, Amplifier	8- 17 kW	5 mc/sec.	22.0	60	50	C-T	14000	2.0	– 1600	0.40	28000	20000	ML-5668 Water Cooled
ML-5669 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	8- 17 kW	5 mc sec.	22.0	60	50	C-T	14000	2.0	1600	0.40	28000	10000	ML-5669 Forced-Air-Cooled
ML-5681* Water Cooled	#1A	Oscillator, Modulator, Amplifier	52-115 kW	30 mc sec.	12.0	220	25	C-T 110 mcs/sec.	15000 9000	12 12	- 3200 – 3200	2.0 2.0	150000 90000	75000 75000	ML-5681* Water Cooled
ML-5682*▲ Water Cooled	#1A	Oscillator, Modulator, Amplifier	58-215 kW	30 mc/sec.	16.5	325	30	C-T 88 mcs/sec.	16000 9000	20 20	- 3200 – 3200	4.0 2.5	300000 170000	120000 120000	ML-5682*▲ Water Cooled
ML-6256* Water Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	40 mc/sec.	12.6	29	20	C-T	6000	1.5	– 1500	0.22	7000	5000	ML-6256* Water Cooled
ML-6257* Water Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	40 mc/sec.	12.6	29	20	C-T	6000	1.5	- 1500	0.22	7000	5000	ML-6257* Water Cooled
ML-6258* Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	40 mc/sec.	12.6	29	20	C-T	6000	1.5	1500	0.22	7000	3000	ML-6258* Forced-Air-Cooled
ML-6420* Water Cooled	#1A	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc sec.	7.0	85	20	C-T	10000	2.2	– 1600	0.42	20000	12500	ML-6420* Water Cooled
ML-6421* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc sec.	7.0	85	20	C-T	10000	2.2	- 1600	0.42	20000	10000	ML-6421* Forced-Air-Cooled
ML-6421-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc sec.	7.0	85	20	C-T	10000	2.2	1600	0.42	20000	7500	ML-6421-F Forced-Air-Cooled
ML-6422* Water Cooled	#1A	Oscillator, Modulator, Amplifier	12-18 kW	30 mc sec.	7.0	85	90	C-T	12500	2.5	- 1400	0.50	30000	20000	ML-6422* Water Cooled
ML-6423* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	12-18 kW	30 mc sec.	7.0	85	90	C-T	12500	2.5	- 1400	0.50	30000	12500	ML-6423* Forced-Air-Cooled
ML-6423-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	12-18 kW	30 mc sec.	7.0	85	90	C-T	12500	2.5	– 1400	0.50	30000	10000	ML-6423-F Forced-Air-Cooled
ML-6424* Water Cooled	#1A	Oscillator, Modulator, Amplifier	24-30 kW	30 mc sec.	7.0	120	20	C-T	12500	3.5	- 2000	0.50	40000	20000	ML-6424* Water Cooled
ML-6425* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	24-30 kW	30 mc/sec.	7.0	120	20	C-T	12500	3.5	– 2000	0.50	40000	12500	ML-6425* Forced-Air-Cooled
ML-6425-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	24-30 kW	30 mc sec.	7.0	120	20	C-T	12500	3.5	– 2000	0.50	40000	10000	ML-6425-F Forced-Air-Cooled
ML-6426* Water Cooled	#1A	Oscillator, Modulator, Amplifier	46-55 kW	30 mc/sec.	8.0	200	20	C-T	12500	8.0	– 2000	1.0	80000	40000	ML-6426* Water Cooled
ML-6427* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	46-48 kW	30 mc/sec.	8.0	200	20	C-T	12500	8.0	– 2000	1.0	80000	20000	ML-6427* Forced-Air-Cooled
ML-6576 Water Cooled	#2C	Oscillator, Modulator, Amplifier	36 kW	25 mc/sec.	7.5	170	5.5	C-T SSB	10000 12000	6.0 5.0	- 2400 —	0.20 —	60000 45000	22500 22500	ML-6576 Water Cooled

ML-6696*▲▲ Water-Cooled	#1A	Oscillator, Modulator, Amplifier	72-80 kW	30 mc sec.	13.0	205	20	C-T	16000	11	3200	2.0	120000	60000	**ML-6696***▲ Water-Cooled
ML-6697 *▲▲† Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	72-80 kW	30 mc sec.	13.0	205	20	C-T	16000	11	3200	2.0	120000	35000	**ML-6697** *▲▲† Forced Air Cooled
ML-7479A* Vapor Cooled	#1C	Oscillator, Modulator, Amplifier	—	30 mc sec.	8.0	200	20	CT	12500	8	2000	1.0	90000	50000	**ML-7479A*** Vapor Cooled
ML-7480A* Vapor Cooled	#1C	Oscillator, Modulator, Amplifier	—	30 mc sec.	13.0	205	20	CT	150000	11	3200	2.0	150000	80000	**ML-7480A*** Vapor Cooled
ML-7482*♣ Vapor Cooled Ceramic	#1C	Oscillator, Modulator, Amplifier	330-440 kW	30 mc sec.	14.5	450	45	CT	20000	30	−1500	4.0	600000	200000	**ML-7482***♣ Vapor Cooled Ceramic
ML-7560*♣ Water Cooled Ceramic	#1A	Oscillator, Modulator, Amplifier	330-440 kW	30 mc sec.	14.5	450	45	CT	20000	30	−1500	4.0	600000	175000	**ML-7560***♣ Water Cooled Ceramic
ML-8317*♣ Forced Air-Cooled Ceramic	#1A	Oscillator, Modulator, Amplifier	175 kW	30 mc sec.	14.5	450	45	CT	20000	20	1500	3.0	250000	60000	**ML-8317***♣ Forced-Air-Cooled Ceramic
ML-8547* Water-Cooled	#1D	Oscillator, Modulator, Amplifier	190 kW	30 mc/sec.	14.5	450	14	C-T	11000	30	−3500	—	—	175000	**ML-8547*** Water-Cooled
ML-8618* Water-Cooled	#1D	Magnetic Beam — High Gain Triode Oscillator, Modulator, Amplifier	200 kW	30 mc/sec.	7.5	320	25	C-T	17000	20	−4000	—	—	55000	**ML-8618*** Water-Cooled

***New Equipment design interest**

Design Group
- **#1A*** Coaxial terminal triode. Thoriated tungsten, self supporting, cathode. Heavy wall anode.
- **#1B*** Modified coaxial design. Thoriated-tungsten cathode. Heavy wall anode.
- **#1C*** Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall vapor-cooled anode.
- **#1D*** Same as #1C* except that tube employs ceramic envelope

Design Group
- **#2A** "Post & dish" terminal triode. Pure tungsten cathode. Light wall anode
- **#2B** "Post & dish" terminal triode. Pure tungsten, self-supporting, cathode (or variation). Heavy wall anode.
- **#2C** "Post & dish" terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.

Design Group
- **#3** Long envelope structure. Pure tungsten cathode. Light wall anode.

▲Also available with a ceramic envelope, designated ML-5682K

▲▲Also available with ceramic envelope, order ML-6696A or ML-6697A.

†A version of the ML-6697 with ruggedized grid is available; order ML-466R. Similarly a ruggedized grid version of the ML-6697A is available; order ML-466RA.

♣Also available with Vac-ion pump.

C-T: RF Power Amplifier and Oscillator, Class C Telegraphy.

SSB: RF Power Amplifier and Oscillator, Class C Telegraphy.

TETRODES

TUBE TYPE	Application	Power Range Class C	Maximum Frequency for Full Power Operation	FILAMENT Voltage Volts	FILAMENT Current Amps	Mu	Class of Service	PLATE Voltage Vdc	PLATE Current Adc	MAXIMUM RATINGS SCREEN GRID Voltage Vdc	MAXIMUM RATINGS CONTROL GRID Voltage Vdc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-7007* Forced Air-Cooled	VHF Television Service	6- 10 kW	220 mc sec.	5.0	180	10	B	7500	4.0	2000	- 155	24000	12000	**ML-7007*** Forced-Air-Cooled
ML-8170/ 4CX5000A*▲ Forced-Air-Cooled	Oscillator, Amplifier, Modulator	16 kW	30 mc/sec. 110 mc/sec. †	7.5	75	4.5	C-T	7500	3	1500	−600	22000	5000	**ML-8170/ 4CX5000A***▲ Forced-Air-Cooled
ML-8171/ 4CX10000D* Forced-Air-Cooled	Oscillator, Amplifier, Modulator	16 kW	30 mc/sec. 110 mc/sec. †	7.5	75	4.5	C-T	7500	3	1500	−600	22000	10000	**ML-8171/ 4CX10000D*** Forced-Air-Cooled
ML-8281/ 4CX15000A* Forced-Air-Cooled	Oscillator, Amplifier, Modulator	36 kW	30 mc/sec 110 mc/sec.†	6.3	160	4.5	C-T	10000	5	2000	−800	50000	15000	**ML-8281/ 4CX15000A*** Forced-Air-Cooled
ML-8545* Vapor-Cooled	Oscillator, Amplifier, Modulator	330 kW	50 mc/sec.	12	400	5	C-T	18000	25	2500	−1500	450000	150000	**ML-8545*** Vapor-Cooled

TETRODES — continued

TUBE TYPE	Application	Power Range Class C	Maximum Frequency for Full Power Operation	FILAMENT Voltage Volts	FILAMENT Current Amps	Mu	Class of Service	PLATE Voltage Vdc	PLATE Current Adc	MAXIMUM RATINGS SCREEN GRID Voltage Vdc	MAXIMUM RATINGS CONTROL GRID Voltage Vdc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-8546* Water-Cooled	Oscillator, Amplifier, Modulator	330 kW	50 mc/sec.	12	400	5	C-T	18000	25	2500	−1500	450000	150000	ML-8546* Water-Cooled
ML-8661/ 4CW10000A* Water-Cooled	Oscillator, Amplifier, Modulator	16 kW	30 mc/sec. 110 mc/sec. †	7.5	75	4.5	C-T	7500	3	1500	−600	22000	12000	ML-8661/ 4CW10000A* Water-Cooled

*New Equipment design interest.
▲Also available in ruggedized version as ML-8170W/4CX5000R.
†At slightly reduced power.

C-T: RF Power Amplifier and Oscillator, Class C Telegraphy.
B: RF Power Amplifier, Class B Television Service

PULSE MODULATORS

TUBE TYPE	Design Group	Application	Typical Pulse Power	FILAMENT Voltage Volts	FILAMENT Current Amps.	MAXIMUM RATINGS PLATE Voltage Vdc	PLATE Voltage Peak - kv	PLATE Current mAdc	PLATE Current Peak† Amps.	GRID Voltage Volts	GRID Voltage Peak positive Volts	These ratings are not necessarily simultaneous Pulse Duration	Duty Factor	Plate Dissipation	TUBE TYPE
ML-6544* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output 1 Mw	6.0	60	20000	25	250	75	−600	1500	6 μsec.	0.03	1 kW	ML-6544* Forced-Air-Cooled
ML-7002* Liquid Cooled ML-7715* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output 3.5 Mw	6.0	60	65000	70	250	90	−600	1500	25 μsec.	0.03	3 kW	ML-7002* ML-7715*
ML-7003* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output 2.5 Mw	6.0	60	45000	50	250	90	−600	1500	25 μsec.	0.03	3 kW	ML-7003* Forced-Air-Cooled
ML-7248* Radiation Cooled	#2	Tetrode for Pulse Generation (Oil Insulated)	Typical Pulse Output 0.15 Mw	6.3	11.7	—	125	—	2.0	−420	350 (1000‡)	Millisecond Range	—§	0.2 kW	ML-7248* Radiation Cooled
ML-7249* Radiation and Forced Air Cooled	#2	Tetrode for Pulse Generation	Typical Pulse Output 0.15 Mw	6.3	11.7	— —	125 (oil ins.) 65 (air ins.)	— —	2.0	−420	350 (1000‡)	Millisecond Range	—§	0.5 kW (oil) 0.3 kW (air)	ML-7249* Radiation and Forced-Air-Cooled
ML-7560* ● Water Cooled ML-8547* Water Cooled	#1D	Triode for Pulse Generation (ML-7560 — Very high peak current, very high average power) (ML-8547 — Same peak current and high power at lower plate kv)	Typical Pulse Output 15 Mw	14.5▲	450	ML-7560 50000 ML-8547 17000	55 19	—	550	−3500	—	1000 μsec.	0.01	175 kW	ML-7650* ● ML-8547*
ML-7668* Oil Convection Cooled	#1E	Triode for Pulse Generation (Oil Insulated)	Typical Pulse Output 1.75 Mw	12.6	29	150▲	160▲	—	15	1500	1000	Millisecond Range	—§	0.75 kW	ML-7668* Oil Convection Cooled
ML-7845* Forced Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output 4.5 Mw	6.0	60	75000	80	250	90	600	—	25 μsec.	0.03	3 kW	ML-7845* Forced-Air-Cooled
ML-8038* Liquid Cooled	#1B	Triode for Pulse Generation Oil Insulated	Typical Pulse Output 15 Mw	13.0	205	125000	125	—	175	−1500	—	1000 μsec.	0.01	5 kW	ML-8038* Liquid Cooled
ML-8040* Forced-Air-Cooled ML-8041* Water Cooled	#1B	Triode for Pulse Generation	Typical Pulse Output 5 Mw	13.0	205	60000	65	—	175	−1500	—	1000 μsec.	0.01	10 kW 60 kW	ML-8040* ML-8041*
ML-8317* ♣ Forced Air Cooled	#1D	Triode for Pulse Generation (Very high peak current, very high average power	Typical Pulse Output 15 Mw	14.5▲	450	50000	55	—	550	3500	—	1000 μsec.	0.01	60 kW	ML-8317* ♣ Forced-Air-Cooled

ML-8495* Forced-Air-Cooled	#1B	Triode for Pulse Generation (For very high voltage operation)	Typical Pulse Output	3 Mw	12.6	29	160	165	—	22	−1000	—	1000 μsec.	0.008	2.5 kW	**ML-8495*** Forced Air-Cooled
ML-8548* ● Oil-Cooled	#1D	Triode for Pulse Generation (Very high power. Very high voltage)	Typical Pulse Output	20 Mw	11.0	350	180000	180	—	225	−1500	2500	1000 μsec.	0.005	30 kW	**ML-8548*** ● Oil-Cooled
ML-8618* Water Cooled	#1D	Magnetic Beam Triode (Very low drive for full output)	Typical Pulse Output	8 Mw	7.5	320	50000	55	—	200	−15000	2500	10000 μsec.	0.06	80 kW	**ML-8618*** Water Cooled
ML-DP15* Oil-Cooled	Coaxial Triode	High Mu Triode for Pulse Generation	Typical Pulse Output	20 Mw	13	210	150000	150	—	175	−1500	2200	1000 μsec.	0.01	1 kW	**ML-DP15*** Oil-Cooled
ML-LPT17* ● Oil Cooled	#1D	Triode for Pulse Generation (Very high power. Extremely high voltage)	Typical Pulse Output	20 Mw	11.0	350	200000	200	—	225	−1500	2500	1000 μsec.	0.005	30 kW	**ML-LPT17*** ● Oil-Cooled
TETRODE FOR PULSE MODULATION		**ML-7007:**	.8 Mw	at	24 kV	**ML-8546:**	10 Mw	at	40 kV							**TETRODE FOR PULSE MODULATION**

***New Equipment design interest.**

Design Group #1A* Shielded Grid Triode. Unipotential oxide cathode; external anode. Beamed electrode design; shield grid protects cathode from arcs; stable operation at high voltage. High mu and low grid current provide low drive.
Design Group #1B* Similar to 1A; employs internal anode.
Design Group #1C* Similar to 1A; ceramic envelope.
Design Group #1D* Coaxial terminal triode; ceramic envelope.
Design Group #1E* Internal anode triode; thoriated-tungsten filament.
Design Group #2* Internal anode tetrode.

♣Also available with Vac-ion pump. ● Supplied with Vac-ion pump.

†Pulse cathode current
‡Maximum screen voltage
§Depends on mode of operation
▲For operation at voltages above 125 pkv, consult the Machlett Engineering Department.
^For cathode currents over 350 amps; filament voltage must be 15.0 volts.

PLANAR TRIODES

TUBE TYPE	Design Group	UHF Application	Maximum Frequency of Operation for Full Ratings	FILAMENT Voltage Volts	FILAMENT Current Amps.	Mu	Sm	Duty	MAXIMUM RATINGS PLATE Volts	MAXIMUM RATINGS PLATE Current Amps.	MAXIMUM RATINGS GRID Voltage Volts	MAXIMUM RATINGS GRID Current Amps.	Average Plate Dissipation Watts	TUBE TYPE
ML-2C39A Forced-Air-Cooled	#3	Oscillator, Amplifier, Frequency Multiplier	2500 mc sec.	6.3	1.0	100	24000	CW	1000	0.1	−150	0.050	100	**ML-2C39A** Forced-Air-Cooled
ML-2C39WA Forced-Air-Cooled	#2	Oscillator, Amplifier, Frequency Multiplier	2500 mc sec.	6.0	1.0	100	25000	CW	1000	0.1	−150	0.050	100	**ML-2C39WA** Forced-Air-Cooled
ML-2C41 Forced-Air-Cooled	#3	Plate-pulsed Oscillator, Amplifier	3000 mc sec.	6.3	1.03	100	25000	0.0025	3500‡	4.0§	−150	2.5§	35	**ML-2C41** Forced-Air-Cooled
ML-6442* Conduction-Convection Cooled	#1	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier Oscillator, Amplifier, Frequency Multiplier	5000 mc/sec. 2500 mc/sec.	6.3	0.90	50	16500	0.001 CW	3000‡ 350	2.5§ .035	−100 − 50	1.25§ .015	7.5 8	**ML-6442*** Conduction-Convection Cooled
ML-6771* Conduction-Convection Cooled	#1	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier Oscillator, Amplifier, Frequency Multiplier	6000 mc/sec. 4000 mc/sec.	6.3	0.57	90	23000	0.001 CW	2000 300	1.25 0.025	−25 −25	0.50 0.008	3 6.25	**ML-6771*** Conduction-Convection Cooled
ML-7209 Forced-Air-Cooled	#2	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier (High shock ratings)	3000 mc sec.	6.0	1.0	100	25000	.0033	3500‡	3.0§	−150	1.5§	35	**ML-7209** Forced-Air-Cooled
ML-7210* Forced-Air-Cooled	#2	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier Oscillator, Amplifier, Frequency Multiplier 12 second warm up cathode	3000 mc sec 2500 mc sec	6.3	0.85	75	17000	CW 0.0025	1000 3500‡	.075 2.8§	150 −150	0.030 1.2§	100 25	**ML-7210*** Forced-Air-Cooled
ML-7211* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier (High cathode current capability)	2500 mc sec.	6.3	1.3	80	30000	CW	1000	0.15	−150	0.045	100	**ML-7211*** Forced-Air-Cooled
ML-7289/3CX100A5* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier	2500 mc sec	6.0	1.0	100	25000	CW	1000	0.1	−150	0.050	100	**ML-7289/3CX100A5*** Forced-Air-Cooled
ML-7698*▲ Conduction-Convection Cooled	#1	Plate- or Grid-pulsed Oscillator, Amplifier, Frequency Multiplier (High cathode current capability)	3000 mc/sec.	6.3	1.3	80	30000	0.0033	3500‡ 2000 (grid pulsed)	5.0§	−150	2.5§	10†	**ML-7698*▲** Conduction-Convection Cooled

PLANAR TRIODES — continued

TUBE TYPE	Design Group	UHF Application	Maximum Frequency of Operation for Full Ratings	FILAMENT Voltage Volts	FILAMENT Current Amps.	Mu	Sm	MAXIMUM RATINGS Duty	PLATE Volts	PLATE Current Amps.	GRID Voltage Volts	GRID Current Amps.	Average Plate Dissipation Watts	TUBE TYPE
ML-7815/3CPN10A5* Conduction Convection Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.0	1.0	100	25000	.0033 .0033 CW	3500 2000 2000	3.0§ 4.8§ 0.1	– 150	1.8 1.8§ 0.050	10†▲	**ML-7815/3CPN10A5*** Conduction-Convection Cooled
ML-7855* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier (Frequency stable anode)	2500 mc sec.	6.0	1.0	80	25000	CW	1000	0.125	– 150	0.030	100	**ML-7855*** Forced-Air-Cooled
ML-8403* Forced-Air-Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.0	1.25	80	30000	.0033 .0033 CW	3500 2000 2000	5.0§ 5.0§ .15	– 150	2.5§ 2.5§ .045	58 33 100	**ML-8403*** Forced-Air-Cooled
ML-8533* Forced-Air-Cooled	#1	Plate or Grid-Pulsed Oscillator, Amplifier, Frequency Multiplier, Modulator (As Modulator peak pulse in order of 20kW has been obtained at .001 duty)	3000 mc/sec	6.3	1.3	90	30000	Pulse Modulator	10000§	5.0§	– 150	—	100	**ML-8533*** Forced-Air-Cooled
Miniature **ML-8534*** Conduction/Convection/ Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.3	1.30	80	38000	.0033 .0033 CW	3500 2500 2500	5.0§ 5.0§ .25	– 150	2.0 2.0 .045	10 10 10	Miniature **ML-8534*** Conduction/Convection/ Cooled
Miniature **ML-8535*** Forced-Air-Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.3	1.30	80	38000	.0033 .0033 CW	3500 2500 2500	5.0§ 5.0§ .25	– 150	2.0 2.0 .045	60 60 150	Miniature **ML-8535*** Forced-Air-Cooled
Miniature **ML-8536*** Conduction Convection/ Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.0	1.0	80	30000	.0033 .0033 CW	3500 2500 2500	3.0§ 3.0§ .15	– 150	1.2 1.2 .045	10 10 10	Miniature **ML-8536*** Conduction/Convection/ Cooled
Miniature **ML-8537*** Forced-Air-Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.0	1.0	80	30000	.0033 .0033 CW	3500 2500 2500	3.0§ 3.0§ .15	– 150	1.2 1.2 .045	35 35 150	Miniature **ML-8537*** Forced-Air-Cooled
Miniature **ML-8538*** Conduction/Convection/ Cooled	#1	Plate or Grid Pulsed Oscillator, Amplifier Switch Tube; Frequency Multiplier	3000 mc/sec.	6.3	1.3	90 Cutoff 145 Dynamic	30000	Pulse Modulator	8000 10000§	5.0§	– 150	2.0	10	Miniature **ML-8538*** Conduction Convection Cooled
Miniature **ML-8539*** Forced-Air-Cooled	#1	Plate or Grid Pulsed Oscillator, Amplifier Switch Tube; Frequency Multiplier	3000 mc/sec.	6.3	1.3	90 Cutoff 145 Dynamic	30000	Pulse Modulator	5000 10000§	5.0§	– 150	2.0	100	Miniature **ML-8539*** Forced Air-Cooled
Miniature **ML-8629*** Conduction/Convection/ Cooled	#1	Plate Pulsed, Grid Pulsed or CW Oscillator, Amplifier, Frequency Multiplier	5000 mc/sec.	6.3	.85	90	31000	.0025	3000	3.0§	– 100	1.3	100 with heat sink	Miniature **ML-8629*** Conduction Convection Cooled
Miniature **ML-8630*** Conduction/Convection/ Cooled	#1	Plate Pulsed, Grid Pulsed or CW Oscillator, Amplifier, Frequency Multiplier	6000 mc/sec.	6.3	.57	90	33000	.001	2500	1.5§	– 50	.6	50 with heat sink	Miniature **ML-8630*** Conduction/Convection/ Cooled
Miniature **ML-8631*** Conduction Convection/ Cooled	#1	Plate Pulsed, Grid Pulsed or CW Oscillator, Amplifier, Frequency Multiplier	5000 mc/sec.	6.3	.85	145	30000	.0025	3000	3.0§	– 100	1.3	100 with heat sink	Miniature **ML-8631*** Conduction/Convection/ Cooled
Miniature **ML-8741*** Conduction/Convection/ Cooled	#1	Plate Pulsed Oscillator and Amplifier Grid Pulsed Oscillator and Amplifier CW Oscillator and Amplifier	3000 mc/sec. 3000 mc/sec. 2500 mc/sec.	6.3	1.30	80	38000	.0033 .0033 CW	3500	5.0§ 5.0§ .25	– 150	2.0 2.0 .045	10 10 10	Miniature **ML-8741*** Conduction/Convection/ Cooled

***New Equipment design interest.**

Design Group #1 Ceramic envelope; coaxial terminals; ruggedized planar electrodes; tightly held concentricity tolerances, exacting production specifications. Low interelectrode capacitance; low lead inductance; close production and testing control of cathode activity.

Design Group #2 Similar to Group #1 except for use of glass envelope.

Design Group #3 Glass envelope; coaxial terminals; planar electrodes. Low interelectrode capacitance; low lead inductance.

†Greater anode dissipation may be achieved with Conduction — and/or Forced-Air-Cooling.
‡Plate pulsed
§Peak
▲Plate dissipation up to 100 watts is obtainable on tube furnished with radiator (ML-7815R) and appropriate forced-air cooling.

NOTE: Water Jackets are available for ML-8534 through ML-8539.

NOTE: The UHF Planar Diode ML-322 is available for service, typically as modulation clipper, to 800v peak inverse, at 0.60 amps.

DIODES

TUBE TYPE	Design Group	Application	GENERAL CHARACTERISTICS FILAMENT Insulating Medium	FILAMENT Voltage Volts	FILAMENT Approx. Current Amps.	ANODE Peak Inverse Anode Voltage PKV	ANODE Peak Anode Current Amps.	MAXIMUM RATINGS Circuit	Load Current Rating Unfiltered† Amps.	Load Current Rating Filtered‡ Amps.	TUBE TYPE
ML-102A* Radiation Cooled	#1A	Electrostatic Particle Precipitation Service	Air	20	19	75	0.75	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.48 0.72	0.75 0.75	**ML-102A*** Radiation Cooled
ML-141* Radiation and Forced-Air-Cooled	#1A	Electrostatic Particle Precipitation Service	Air or Oil	5.5	6.5	80 (Air Insulation) 125 (Oil Insulation)	0.75	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.40 0.60	0.47 0.60	**ML-141*** Radiation and Forced-Air-Cooled
ML-142* Radiation Cooled	#1A	Compact High Voltage Applications	Air or Oil	3.8	6.6	50 (Air Insulation) 100 (Oil Insulation)	0.30	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.15 0.225	0.20 0.225	**ML-142*** Radiation Cooled
ML-5575/100* Radiation Cooled	#1A	Electrostatic Particle Precipitation Service	Air	20	24	150	1.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.64 0.96	1.0 1.0	**ML-5575/100*** Radiation Cooled
ML-5576/200* Radiation Cooled	#1A	Electrostatic Particle Precipitation Service	Air	20	32	150	2.5	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	1.59 2.40	2.50 2.50	**ML-5576/200*** Radiation Cooled
ML-6908* External Anode/ Convection Cooled	#1B	High Power High Voltage Supplies Hold-off Diode Service in Radar Application	Oil	12	23	150▲	10.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	3.20 4.40	3.50 4.50	**ML-6908*** External Anode Convection Cooled
ML-8094/199* Radiation Cooled	#1A	Electrostatic Particle Precipitation Service Hold-off Diode Service in Radar Application	Air	12	23	110	10.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	2.60 3.50	2.90 3.60	**ML-8094/199*** Radiation Cooled
ML-8224* Radiation Cooled	#1C	Voltage Multiplier & Energy Storage Circuit Requiring High Peak Power	Air or Oil	5.5	6.5	80 (Air Insulation) 150 (Oil Insulation)	0.75	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	.270 .375	.250 .375	**ML-8224*** Radiation Cooled
ML-XRT-1	#1A	High Voltage Power Supplies	Oil	6.0	6.8	165	1.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	.36 .54	.39 .54	**ML-XRT-1**

*New Equipment design interest.

Design Group
- #1A* Glass envelope; internal anode. Self-shielding catenary type filament.
- #1B* Glass envelope; external anode. Self-shielding catenary type filament.
- #1C* Glass envelope; internal anode.

†Unfiltered Load Current Ratings are based on sine-wave voltage input and resistance load without inductive or capacitive effects.

‡Filtered Load Current Ratings are based on sine-wave voltage input and infinite inductance choke input filter.

ACCESSORIES

TRIODE & TETRODE ACCESSORIES†

Machlett Tube Type	Description	No. Req'd.	Part No.
	CONNECTORS		
356-880 889RA - 5604 - 5606 5619 - 5658 - 5666 5667 - 5668 - 5669	FILAMENT CONNECTOR with STRAPS	2	F12167
	FILAMENT CONNECTOR without STRAPS	2	F13220
	GRID CONNECTOR with JUMPER & STRAPS	1	F8540
	GRID CONNECTOR with JUMPER without STRAPS	1	F13221
5681 - 5682 5682K	FILAMENT CONNECTOR (small)	1	F12589
	FILAMENT CONNECTOR (large)	1	F12590
	GRID and ANODE CONNECTOR	1 ea.	F12591
5530 - 5530H - 5531 5541	FILAMENT or GRID CONNECTOR	3, 2 Fil. 1 Grid	P14988
6256 - 6257 6258 - 7668	FILAMENT CONNECTOR (small)	1	F14383
	FILAMENT CONNECTOR (large)	1	F14382
	GRID CONNECTOR††	1	F14381
6420 - 6421 - 6421F 6422 - 6423 - 6423F 6424 - 6425 - 6425F 6426 - 6427	FILAMENT CONNECTOR (small)	1	F17487
	FILAMENT CONNECTOR (large)	1	F17488
	GRID CONNECTOR	1	F17489
6696 - 6696A 6697 - 6697A 7479A - 7480A 8038 - 8040 - 8041	FILAMENT CONNECTOR (small)†	1	F17488
	FILAMENT CONNECTOR (large)	1	F17489
	GRID CONNECTOR	1	F17397
6544 - 7002 - 7003	HEATER CONNECTOR	1	F21989
	CATHODE CONNECTOR	1	F21991
	GRID CONNECTOR	1	F21987
7482 - 7560 8317 - 7482V 7560V - 8317V - 8618	FILAMENT CONNECTOR (small)	1	F27218
	FILAMENT CONNECTOR (large)	1	F27219
	GRID CONNECTOR	1	F27220
8545 - 8546	FILAMENT (small)	1	P510187
	FILAMENT (large)	1	P510188
	CONTROL GRID	1	P510206
	SCREEN GRID	1	F27220
	WATER JACKETS		
356 - 880 - 5658 6576	WATER JACKET with "O" RING GASKET	1	F10690
	"O" RING GASKET	1	P8645
5619 - 6422 - 6424	WATER JACKET with "O" RING GASKET	1	F7963
5666 - 6420	WATER JACKET with "O" RING GASKET	1	F8529
5668	WATER JACKET with "O" RING GASKET	1	F8528
5619 - 5666 - 5668 6420 - 6422 - 6424	"O" RING GASKET	1	P7976
	MOUNTING CLAMP for WATER JACKET	1	F8768
	MOUNTING PLATE for WATER JACKET	1	F8772
6256	"O" RING GASKET	1	P14384
6426	WATER JACKET with "O" RING GASKET	1	F17292
	"O" RING GASKET	1	P17494

†Accessories for the ML-466R and ML-466RA are identical to those for the ML-6697

††This connector is for the ML-6256, 6257, 6258 only.

TRIODE & TETRODE ACCESSORIES

Machlett Tube Type	Description	No. Req'd.	Part No.
6426 - 6696 - 6696A	MOUNTING CLAMP for WATER JACKET (1 if mounted on plate) (2 if mounted on side)	1, 2	P15198
	MOUNTING PLATE for WATER JACKET	1	F15196
6696 - 6696A	WATER JACKET with "O" RING GASKET	1	F17393
	"O" RING GASKET	1	P17494
8041	WATER JACKET with "O" RING GASKET	1	F26720
	MOUNTING PLATE for WATER JACKET	1	F26731
	CLAMP RING for WATER JACKET	1	P26730
	AIR DISTRIBUTORS		
6421	AIR DISTRIBUTOR (Including 3 P21113 Clips)	1	F17796
6423 - 6425	AIR DISTRIBUTOR (Including 3 P21113 Clips)	1	F17797
6427	AIR DISTRIBUTOR (Including 3 P21113 Clips)	1	F17798
6697 - 6697A	AIR DISTRIBUTOR (Including 3 P21113 Clips)	1	F17759
8317 - 8317V	AIR DISTRIBUTOR (Including 3 P27837 Clips)	1	F27836
	TUBE SUPPORTS		
6258	GLASS INSULATED TUBE SUPPORT	1	P21186
891R - 892R - 889RA 5604 - 5667 - 5669 6421F - 6423F - 6425F	TUBE SUPPORT	1	P27453
5530 - 5530H - 6544	TUBE SUPPORT	1	P16891
5531 - 5541 7003 - 7715	TUBE SUPPORT	1	P16893
6421 - 6423 - 6425	TUBE SUPPORT	1	F17794
6427 - 6697 - 6697A	TUBE SUPPORT	1	F17795
8317 - 8317V	TUBE SUPPORT	1	F27814
	MOUNTING SOCKETS		
5681 - 5682 5682K	MOUNTING SOCKET	1	F12527
	"O" RING GASKET for SOCKET	1	P13745
	INNER GASKET for SOCKET	1	P12272
102A - 141 - 5575/100 5576/200 - 8094/199 8224	MOUNTING SOCKET	1	P8835
8170/4CX5000A 8170W/4CX5000R 8171/4CX10000D 8281/4CX15000A 8661/4CW10000A	MOUNTING SOCKET	1	P511451
8170/4CX5000A 8170W/4CX5000R	CHIMNEY	1	P510382
8171/4CX10000D	CHIMNEY	1	P512310
8281/4CX15000A	CHIMNEY	1	P511450

ACCESSORIES

ACCESSORIES FOR MAGNETIC BEAM TRIODES

Machlett Tube Type	Description	No. Req'd	Part No.
8618	FILAMENT CONNECTOR (small)	1	F27218
	FILAMENT CONNECTOR (large)	1	F27219
	GRID CONNECTOR	1	F27220
	WATER JACKET with "O" RING GASKET	1	F512759
	MAGNET	1	P511165
	"O" RING GASKET for WATER JACKET	1	P512372

ACCESSORIES FOR PLANAR TRIODE

7209 - 7211 - 7289 - 7815R 7855 - 7698R - 8403 - 8533 2C39A - 2C39WA - 3CX100A5	TUBE PULLER*	
8534 - 8535 - 8536 8537 - 8538 - 8539	TUBE PULLER	S20508
8629 - 8630 - 8631	TUBE PULLER	S20509
7209 - 7289 - 7698 - 7815 7855 - 8403 - 8533 2C39A - 2C39WA 3CX100A5	WATER JACKET	S20367
8534 - 8536 - 8538	WATER JACKET	S20999
8629 - 8630 - 8631	WATER JACKET	S20992
• • •	PIN TYPE RADIATOR**	P-511952

*Fits most planar triode radiators

**Available for all planar triodes. Must be ordered with tube.

ACCESSORIES FOR OIL OPERATION

Machlett Tube Type	Description	No. Req'd	Part No.
8495	OIL JACKET	1	F27548
8548	OIL JACKET SLEEVE	1	510264
	OIL JACKET BAYONET BASE	1	510268
	FILAMENT CONNECTOR	2	510657
	GRID CONNECTOR	1	510658

MISCELLANEOUS ACCESSORIES

"O" RING GASKET	TUBE SILICONE GREASE	2 oz.	RM6388
AIR DISTRIBUTOR	SPRING LOCKING CLIPS	3	P21113
7560 - 7560V	COUPLING PLUG for WATER JACKET	2	P25795
6697 - 6697A	LIFTING HANDLE		S16840

FLAT GASKETS FOR WATER JACKETS

Machlett Tube Type	Req'd Quant.	Part No.	Suggested Users Net	Mfrs. Net
ML-298A	4	P9675	$ .50	$ .25
ML-342A	1	P9569	.50	.25
	1	P9709		
ML-880	1	P4619	1.50	1.00

Machlett Tube Type	Req'd. Quant.	Part No.
ML-891	1	P4599
ML-892	1	P4599
ML-893A	1	P5962
ML-5606	1	P4599
ML-5658	1	P4619

RAYTHEON

THE MACHLETT LABORATORIES, INC.

A SUBSIDIARY OF RAYTHEON COMPANY

RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS OPERATION • FOURTH AVENUE, BURLINGTON, MASS. 01803

ST-2031A

PRINTED IN U.S.A.

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

5-1-74

(Effective 5-1-74) © 1974 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 5-1-74
Index 5-1-74
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 5-1-74
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 5-1-74
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 11-15-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 5-1-68
3-500Z 11-1-73
3-1000Z/8164 3-15-67
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 1-11-74
3CW5000F3/8243 . . . . . see 3CW5000A3
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 3-1-67
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX1000A7/8283 11-1-68
3CX1500A7/8877 8-1-73
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7480	11-1-68
8873/8874/8875	6-3-73
8874	see 8873
8875	see 8873
8938	5-15-73

TETRODES

4-65A/8165	5-1-62
4-125A/4D21	6-1-67
4-250A/5D22	5-5-70
4-400A/8438	7-20-70
4-400C/6775	4-1-71
4-500A	3-10-72
4-1000A/8166	10-30-66
4CN15A	6-1-68
4CPX250K/8590	4-1-70
4CS250R	9-1-70
4CV8000A	3-15-71
4CV20,000A	6-1-68
4CV35,000A	5-15-66
4CV50,000E	5-1-70
4CV50,000J	7-15-71
4CV75,000A	6-15-71
4CV100,000C/8351	2-1-68
4CV250,000A	3-1-72
4CW800B/F	11-1-73
4CW2000A/8244	6-15-71
4CW10,000A/8661	4-15-63
4CW25,000A	2-1-72
4CW50,000E	7-1-70
4CW50,000J	7-15-71
4CW100,000D	7-1-67
4CW100,000E	9-1-70
4CW250,000A	3-1-71
4CX125C/F	6-1-67
4CX250B/7203 & 4CX250F/7204	5-15-73
4CX250K/8245 & 4CX250M/8246	5-1-68
4CX250R/7580W	6-16-61
4CX300A/8167	8-30-66
4CX300Y/8561	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX350FJ/8904	9-1-71
4CX600B & 4CX600F	3-20-70
4CX600J/8809 & 4CX600JA/8921	8-15-71
4CX1000A/8168	5-1-70
4CX1000K/8352	8-20-66
4CX1500A	12-1-71
4CX1500B/8660	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	4-15-71
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	12-1-70
4W300B/8249	11-1-73
4W20,000A/8173	4-15-64
4X150A/7034 & 4X150D/7035	5-4-70
4X150G/8172	10-15-73
4X500A	1-1-64
6816,6884,7843	11-15-71
6884	see 6816
7843	see 6816
8560A	7-15-71
8876	6-15-71
8930	12-1-73
X2159	7-1-73

PENTODES

5-125B/4E27A	8-15-52
5-500A	5-1-68
5CX1500A	6-6-70
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

PULSE MODULATORS

4PR60C/8252W	6-30-71
4PR65A/8187	2-15-63
4PR125A/8247	3-15-64
4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6	4-4-70
Preformed Contact Finger Stock	6-15-71
HR Heat Dissipating Connectors	12-1-65
SK-300A	4-15-69
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73
SK-410	12-1-73
SK-500	3-15-67
SK-506, SK-516	4-15-69
SK-510	6-15-71
SK-600A, SK-610A	6-15-71
SK-606, SK-626, SK-636B	8-15-66
SK-607	8-15-71

(Cont'd)

OTHER PRODUCTS

SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A, SK-712A	3-15-71
SK-740	8-15-66
SK-760, SK-770	7-27-70
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-860, SK-870	3-15-67
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210	8-15-72

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

5-1-74

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-240A	R
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000F3/8243	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW25,000A3	T
3CW30,000H3	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV75,000A	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203	TET
4CX250F/7204	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4W20,000A/8173	TET
4X150A/7034	TET
4X150D/7035	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
X-2150	TET
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
CROSS-REFERENCE LIST

MAY 1, 1974

(Revised 5-1-74) © 1973 Varian Associates Printed in U.S.A.

EIMAC to JEDEC

EIMAC No.	JEDEC No.
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CPX1500A7	----
3CV1500A7	----
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CV50,000A7	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW20,000H7	----
3CW25,000A3	----
3CW30,000H3	----
3CW30,000H7	----
3CW40,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000A7	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000A7	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	----
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CS250R	----
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV50,000J	----
4CV75,000A	----
4CV100,000C	8351
4CV250,000A	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	----
4CW50,000E	----
4CW50,000J	----
4CW100,000D	----
4CW100,000E	----
4CW250,000A	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250BC	8957
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	----
4CX600F	----
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	----
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	----
177A	----
177WA	6549W
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC No.	JEDEC No.
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8295A	8295A
8403	8403
8432	8432
8533W	8533W
8560A	8560A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8892	8892
8893	8893
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8911	8911
8912	8912
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8959	8959

JEDEC No.	EIMAC No.
2C39A	2C39
2C39WA	2C39
3C24	3C24
4D21	4-125
4D21A	4D21
4E27A	5-12
5D22	4-250
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100T
100TL	100T
152TH	152T
152TL	152T
250TH	250T
250TL	250T
253	253
304TH	304T
304TL	304T
450TH	450T
450TL	450T
575A	575A
592	3-200
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549W	177WA
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	4-400C
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5

JEDEC to EIMAC

JEDEC No.	EIMAC No.
7457	7457
7480	7480
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533	8533
8560A	8560A
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912
8921	4CX600JA
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8957	4CX250BC
8959	8959


Eimac

varian
electron tube and device group

U.S. SALES OFFICES

Boston
400 Totten Pond Road
Building 1
Waltham, Mass 02154
TEL: (617) 890-4560

Chicago
205 W. Touhy Avenue
Park Ridge, Illinois 60068
TEL: (312) 825-6686

Dallas
Richardson Savings & Loan Bldg.
558 So. Central Expressway
Suite 202
P.O. Box 689
Richardson, Texas 75080
TEL: (214) 235-2385

Dayton
Southmoor Building
10 Southmoor Circle
Dayton, Ohio 45429
TEL: (513) 298-7318

Ft. Lauderdale
1101 E. Sample Rd., Suite 106
Light House Point, Fl. 33064
TEL: (305) 943-9495

Atlanta Branch
6650 Powers Ferry Rd., NW
Suite 100
Atlanta, GA 30339
TEL: (404) 252-0045

Clearwater Branch
314 South Missouri
Suite 205
Clearwater, Fla. 33516
TEL: (813) 446-8513

Los Angeles
2901 Wilshire Boulevard, Suite 102
Santa Monica, Calif. 90403
TEL: (213) 828-5588

New York
#25 Route 22
Springfield, New Jersey 07081
TEL: (201) 376-6600

Philadelphia
P.O. Box 256
Cherry Hill, New Jersey 08002
TEL: (609) 428-6800

Phoenix
7117 Third Avenue, Suite 106
Scottsdale, Arizona 85251
TEL: (602) 947-5461

San Francisco
4940 El Camino Real
Los Altos, California 94022
TEL: (415) 968-7630

Syracuse
115 Twin Oaks Drive
Syracuse, New York 13206
TEL: (315) 437-2568

Washington, D.C.
4701 Lydell Drive
Cheverly, Maryland 20781
TEL: (301) 773-7010 thru 7017

INTERNATIONAL SALES OFFICES

Australia
Varian Pty. Ltd.
82 Christie Street
St. Leonards 2065
New South Wales, Australia
TEL: 43-0673

Varian Pty. Ltd.
679 Springvale Road
North Springvale, VICT. 3171
Australia
TEL: 560-7133

Benelux
Varian Benelux N.V.
Maassluisstraat 100
P.O. Box 9158
Amsterdam, Holland
TEL: (020) 15 94 10

Brazil
Varian Industria e Comercio Ltda.
Alameda Lorena 1834
Sao Paulo, Brazil 01424
TEL: 80-80-27

Canada
Varian Associates of Canada, Ltd.
45 River Drive
Georgetown, Ontario, Canada
TEL: (416) 457-4130

France
Varian S.A.
Quartier de Courtaboeuf
Boite Postale No. 12
91401 Orsay, France
TEL: 907-78-26

Germany
Varian GmbH
Breitwiesenstrasse 9
7 Stuttgart 80 (Vaihingen)
Germany
TEL: (0711) 73 20 28

Italy
Varian SpA
Via Fratelli Varian
10040 Leini (Torino)
Italy
TEL: (011) 26 80 86

Japan
Marubun Corporation
1-1, Nihombashi Odemmacho 2-Chome
Chuo-Ku, Tokyo, 103 Japan
TEL: (03) 662-8151

Scandinavia
Varian AB
Skytteholmsvagen 7D
P.O. Box 1099
17122 Solna 1, Sweden
TEL: (08) 82 00 30

Switzerland
Varian AG
Steinhauserstrasse
6300 Zug, Switzerland
TEL: (042) 23 25 75

United Kingdom and Ireland
EMI-Varian Ltd
248 Blyth Road
Hayes,
Middlesex UB3 1HR
England
TEL: 01-573 5555

5-1-74

Printed in U.S.A.

TECHNICAL DATA

8933

PLANAR TRIODE

The 8933 is a miniature, ceramic/metal, rugged planar triode for advanced airborne and space applications up to 3.0 GHz.



The 8933 may be used as an amplifier, oscillator, or frequency multiplier in the grid- or plate-pulsed mode as well as a modulator or regulator tube. In addition to low interelectrode capacitance, high transconductance and amplification factor, the 8933 has an arc-resistant cathode, and a spewing shield, assuring stable, reliable, and long-life operation under adverse conditions.

The 8933 is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced air cooling permitting an anode dissipation up to 150 watts can be furnished on separate order.

The 8933 is especially designed for applications where high RF pulse power is required. It can also be readily used in switch tube applications up to 8 kV dc.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b = 160 mA	38	mmhos
Amplification Factor (Average):	120	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	9.5	pF
Cout	0.06	pF
Cgp	1.40	pF
Cut-off Bias[3]	-30	V max
Frequency of Maximum Rating:		
Plate or Grid-Pulsed	3.0	GHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

Effective 11-15-72 © by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.50 in; 38.10 mm
Diameter	.950 in; 24.13 mm
Net Weight	0.7 oz; 19.3 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Cooling	Conduction, convection, forced air, or liquid

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance [1] (grounded cathode connection)			
Cin	8.5	11.0	pF
Cout	---	0.06	pF
Cgp	1.30	1.55	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE(grid pulsed)	8000 VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	10,000 VOLTS
DC GRID VOLTAGE	-300 VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE	
Grid negative to cathode	-750 VOLTS
Grid positive to cathode	175 VOLTS
PULSE PLATE CURRENT	5.0 AMPERES
PULSE GRID CURRENT	2.5 AMPERES
AVERAGE PLATE DISSIPATION	
Forced Air Cooling [1]	150 WATTS
GRID DISSIPATION (Average)	1.5 WATTS
FREQUENCY	3.0 GHz
PULSE DURATION [2]	6.0 μs
DUTY FACTOR [2]	.0033

OPERATING CONDITIONS for 8933 in Representative Application

GRID PULSED AMPLIFIER	Driver	Amp	
Frequency	1030	1030	GHz
Heater Voltage	5.8	5.8	V
DC Plate Voltage	4700	5000	Vdc
DC Grid Voltage	-70	-70	Vdc
Peak Video Plate Current	1.5	3.3	a
Peak Video Grid Current	0.25	1.1	a
Pulse Drive Power(approx.)	300	2000	w
Useful Power Output(approx.)	3250	8000	w
Gain	10.4	6.0	dB
Plate Efficiency	46	48	%

1. Using proper EIMAC radiator.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000 VOLTS
PEAK PLATE VOLTAGE	10,000 VOLTS
DC GRID VOLTAGE	-150 VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE	
Grid negative to cathode	-750 VOLTS
Grid positive to cathode	100 VOLTS
PULSE CATHODE CURRENT	7.5 AMPERES
DC PLATE CURRENT	150 MILLIAMPERES
AVERAGE PLATE DISSIPATION	
Forced Air Cooling [1]	150 WATTS
GRID DISSIPATION (Average)	1.5 WATTS
PULSE DURATION [2]	6.0 μs
CUT-OFF MU	85

1. Using proper EIMAC radiator.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	1.160	- -	- -	29.46	- -
B	- -	0.960	- -	- -	24.38	- -
C	- -	0.895	- -	- -	22.73	- -
D	0.825	0.875	- -	20.96	22.23	- -
E	0.702	0.740	- -	17.83	18.80	- -
F	0.655	0.684	- -	16.64	17.37	- -
G	0.150	0.190	- -	3.81	4.83	- -
H	- -	0.040	- -	- -	1.02	- -
J	- -	0.340	- -	- -	8.64	- -
K	0.537	0.554	- -	13.64	14.07	- -
L	- -	0.260	- -	- -	6.60	- -
M	0.545	0.570	- -	13.84	14.48	- -
N	- -	0.200	- -	- -	5.08	- -
P	0.775	0.785	- -	19.69	19.94	- -
R	0.595	0.607	- -	15.11	15.42	- -
S	0.935	0.950	- -	23.75	24.13	- -
T	0.235	0.265	- -	5.97	6.73	- -
U	0.440	0.460	- -	11.18	11.68	- -
AA	- -	- -	0.925	- -	- -	23.50
AB	- -	- -	0.778	- -	- -	19.76
AC	- -	- -	0.598	- -	- -	15.19

Notes:

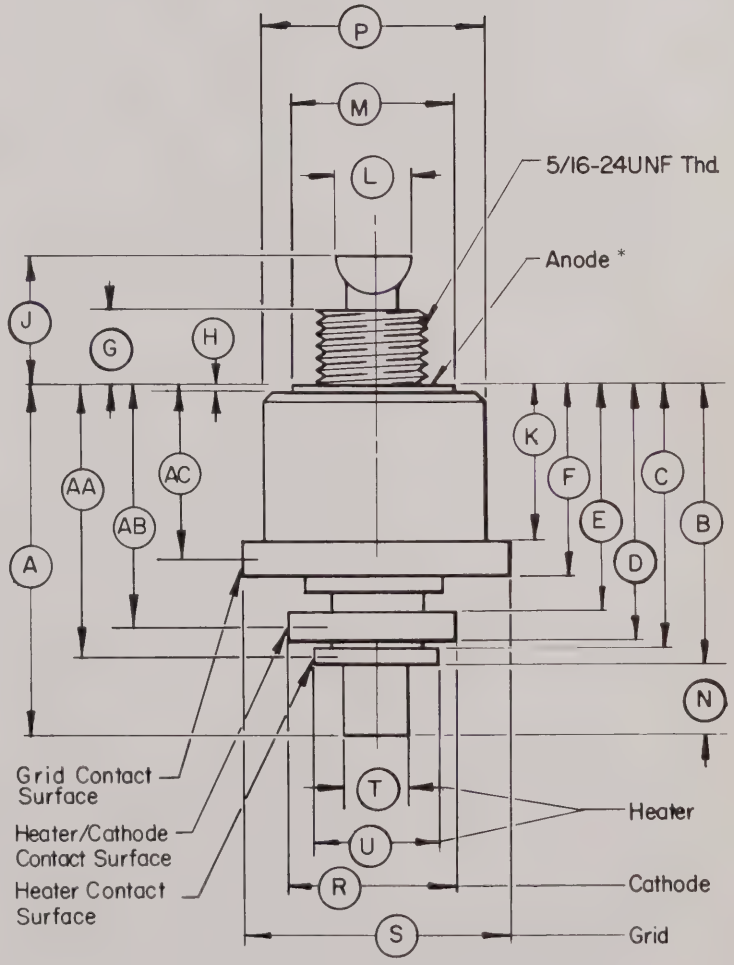
A. Reference Dimensions are for information only and are not required for inspection purposes.

B. Anode Flange is for electrical contact; Stud is for heat transfer.

C.* Total indicated runout (TIR) of Contact Surfaces shall be gaged from centerline of reference & shall be as follows:

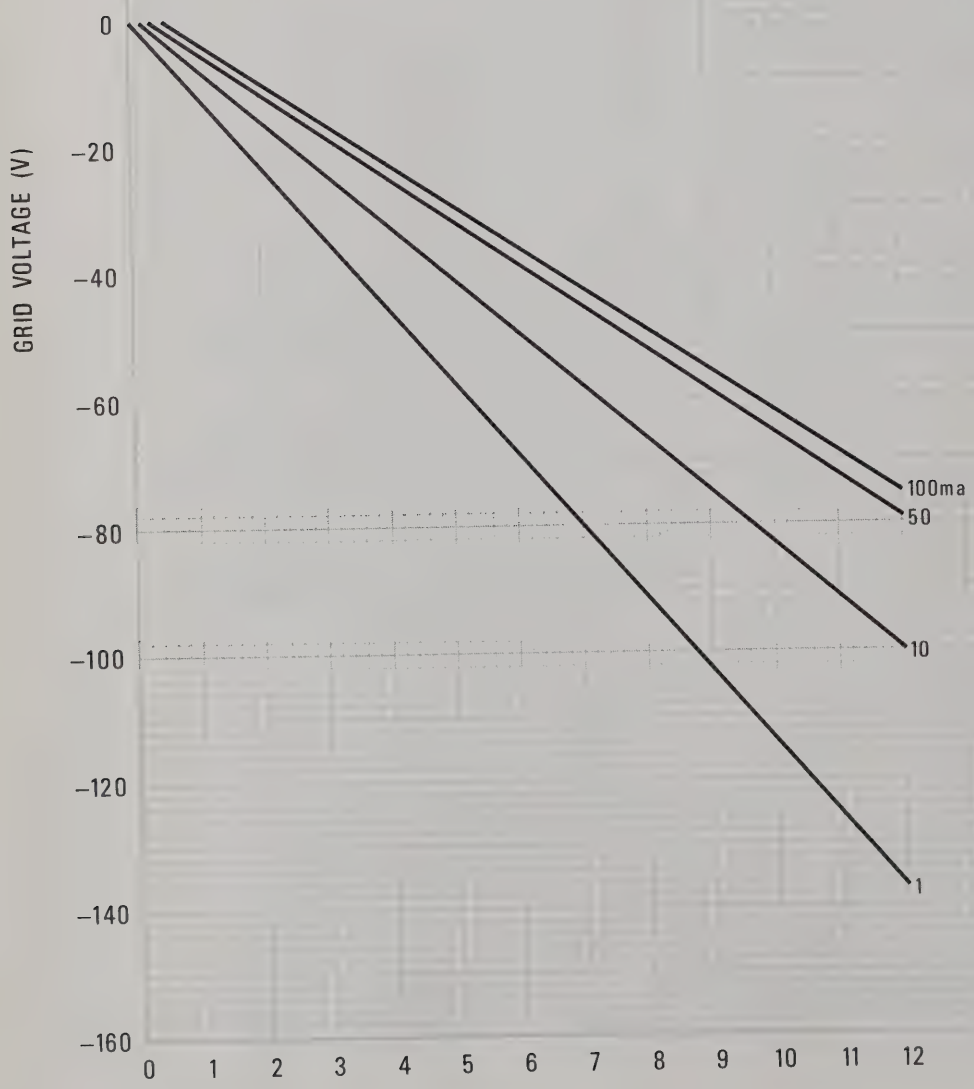
CONTACT SURF.	TIR(Max.)	Ref.
Grid	.020	Anode
Heater	.020	Anode
Cathode	.020	Anode

D. Electrode Contact Dimensions are given for socket design purposes & are not intended for inspection purposes.

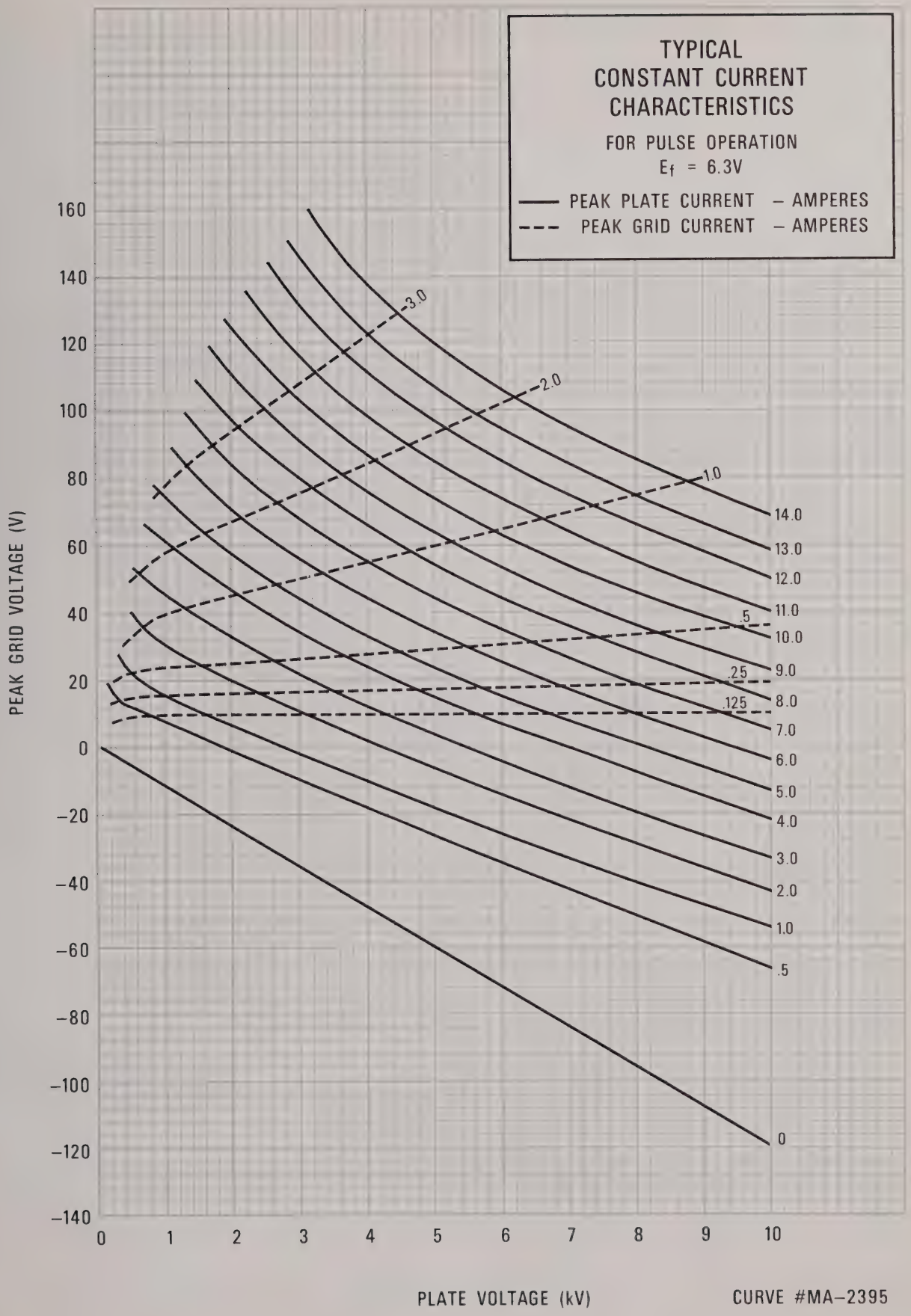


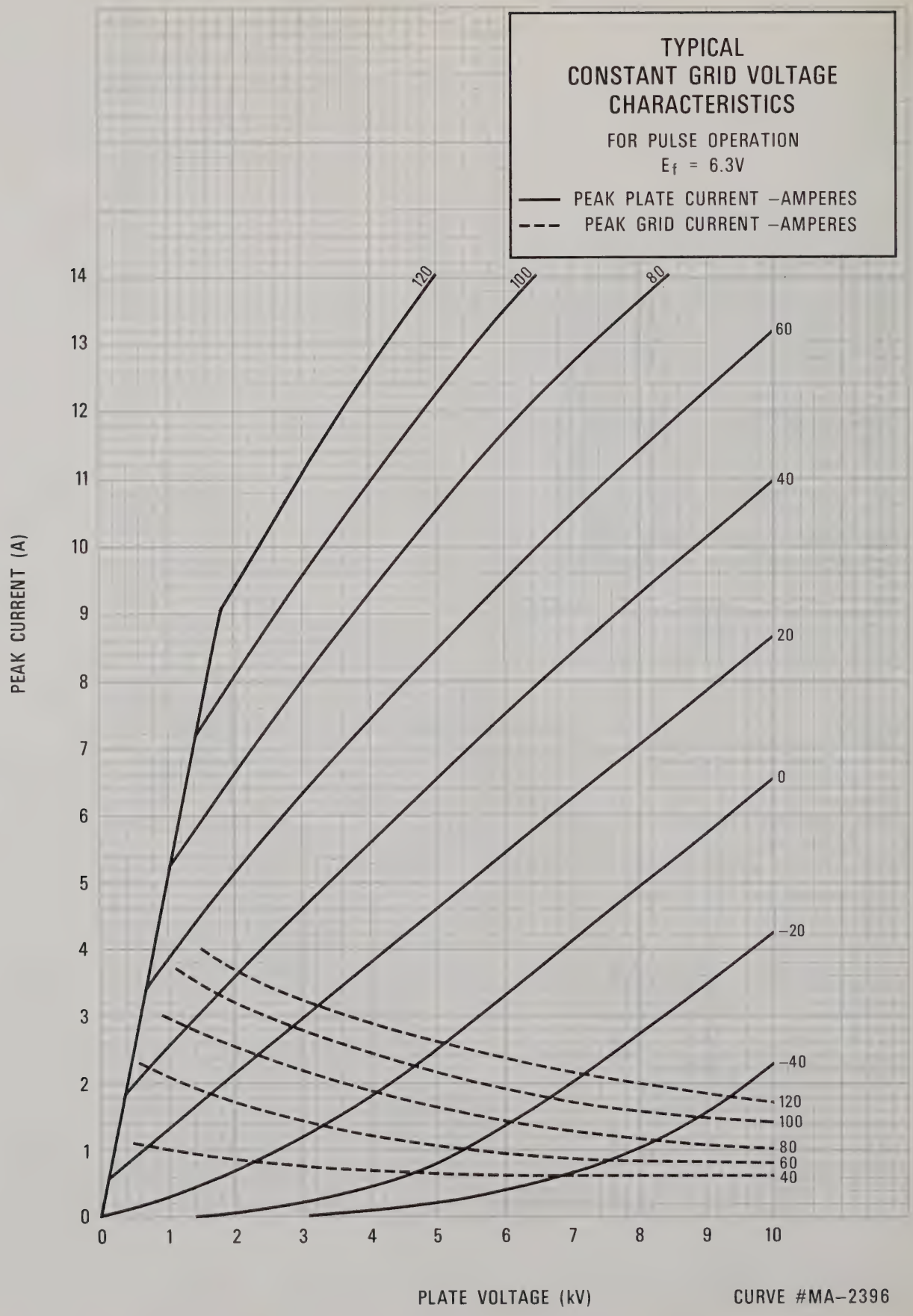
TYPICAL CONSTANT PLATE CURRENT CHARACTERISTICS

NEGATIVE GRID REGION E_f = 6.3V



CURVE #MA−2397


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PEAK PLATE CURRENT – AMPERES
PEAK GRID CURRENT – AMPERES
PEAK GRID VOLTAGE (V)
160
140
120
100
80
60
40
20
0
−20
−40
−60
−80
−100
−120
−140
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE (kV)
3.0
2.0
1.0
.5
.25
.125
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.5
0
CURVE #MA–2395



CURVE #MA–2396

TECHNICAL DATA

3-500Z

HIGH-MU
POWER TRIODE

The EIMAC 3-500Z is a compact power triode intended to be used as a zero-bias Class-AB2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3-500Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.2 A
Amplification Factor (Average)	130
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	8.3 pF
Output	0.07 pF
Feedback	4.7 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Input	8.3 pF
Output	4.7 pF
Feedback	0.07 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.00 in; 152.40 mm
Diameter	3.44 in; 87.33 mm
Net Weight	7.0 oz; 198.5 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	5 Pin Special

(Revised 11-1-73) © 1968, 1970, 1973 by Varian

Printed in U.S.A.

Recommended Socket . . . . . EIMAC SK-410
Recommended Chimney . . . . . EIMAC SK-406
Recommended Heat-Dissipating Connector:
Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[3,4]	400	400	400	400	400	mAdc
Two-Tone Plate Current	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	Ω
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	---	---	---	-46	-45	db

1. Zener diode positive bias used at plate potentials of 3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of circuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two equal tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN, CATHODE DRIVEN

Class AB_2 and C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	0	-75	0	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	---	187	215	215	v
Measured Driving Power	30	22	87	98	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	250	305	W
Useful Output Power	720	850	750	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	330	WATTS
GRID DISSIPATION[2]	20	WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	3000	Vdc
Grid Voltage	-100	Vdc
Plate Current	275	mAdc
Grid Current[1]	120	mAdc
Peak rf Grid Voltage[1]	200	v
Calculated Driving Power	25	W
Plate Input Power	825	W
Plate Dissipation	185	W
Plate Output Power	640	W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_2, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE[1]	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per Tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[2]	300	mAdc
Max. Signal Plate Current	770	mAdc
Max. Signal Grid Current[2]	244	mAdc
Peak af Grid Voltage[3]	100	v
Peak Driving Power[4]	25	w
Plate Input Power	2310	W
Max. Signal Plate Dissipation	890	W
Plate Output Power	1420	W
Load Resistance (plate to plate)	8600	Ω

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurment. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	13.5	14.7	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	6.5	10.0	pF
Output	---	0.18	pF
Feedback	4.2	5.2	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	6.5	10.0	pF
Output	4.2	5.2	pF
Feedback	---	0.18	pF
Zero Signal Plate Current: (E_c = 0Vdc, E_b = 2500 Vdc)	90	180	mAdc

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 3-500Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

SOCKET - The EIMAC SK-410 air system socket and SK-406 chimney are recommended for use with the 3-500Z. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the EIMAC SK-410 is employed, the user must assure himself that lateral pressure is not applied to the tube pins and base seal. Otherwise damage to the tube may result.

CAUTION-GLASS IMPLOSION - The EIMAC 3-500Z is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. Air-flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches-WC)
300	6.6	.023
400	10.3	.052
500	13.0	.082

The anode of the 3-500Z operates at a visibly red color at its maximum rated dissipation of 500 watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500Z tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3-inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon. Suitable products are manufactured by the Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate voltages over 3000 since plate dissipation may be exceeded. A zener diode placing positive bias on the cathode or other constant voltage source may be used to reduce zero signal plate current at plate potentials over 2500 volts.

CLASS-C OPERATION - Although specifically designed for linear amplifier service, the 3-500Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-500Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-resistor bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 3-500Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

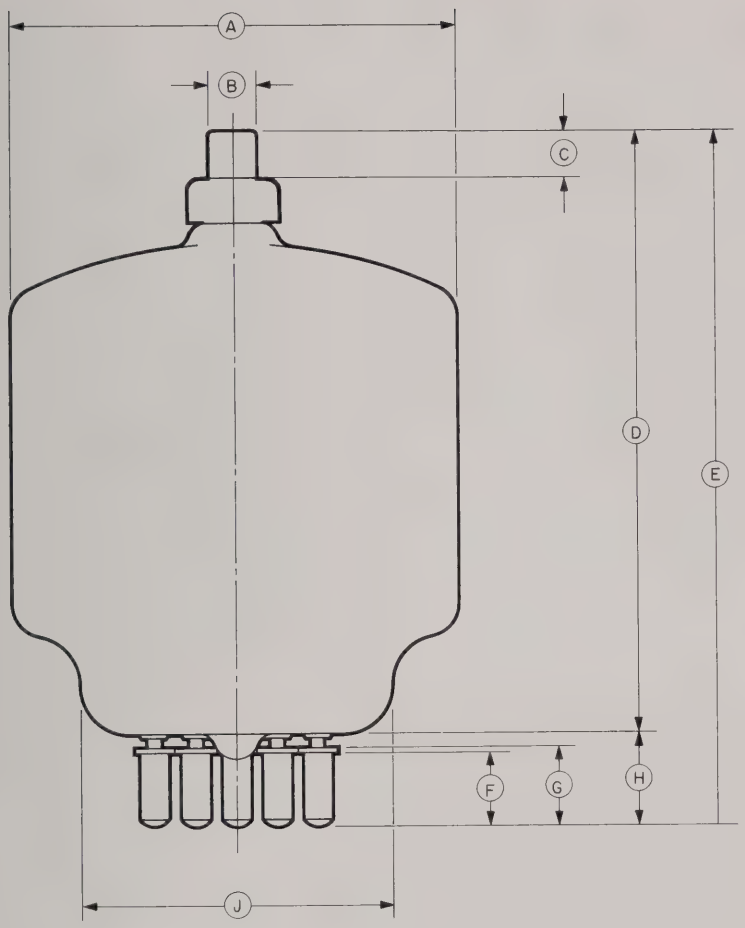
CAUTION-HIGH VOLTAGE - Operating voltage for the 3-500Z can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERMODULATION DISTORTION - Typical operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted.

INPUT CIRCUIT - When the 3-500Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of two or more.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendation.

3-500Z OUTLINE DRAWING AND PIN CONNECTIONS

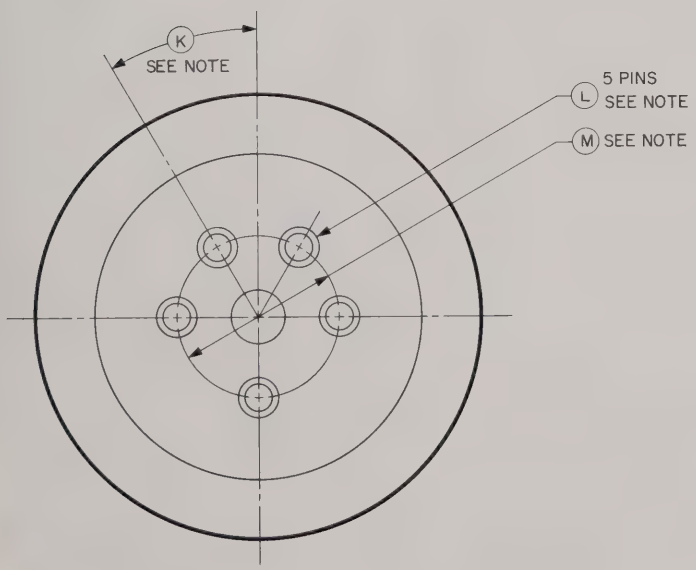


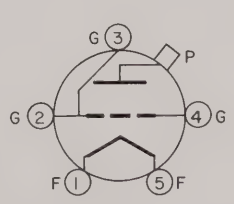
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	3.438	- -	- -	87.33	- -
B	0.350	0.365	- -	8.87	9.27	- -
C	0.328	0.359	- -	8.33	9.12	- -
D	- -	- -	4.844	- -	- -	123.04
E	5.500	6.000	- -	139.70	152.40	- -
F	0.625	0.750	- -	15.87	19.05	- -
G	0.688	0.812	- -	17.48	20.62	- -
H	- -	- -	0.906	- -	- -	23.01
J	- -	2.500D	- -	- -	63.50	- -
K	- -	- -	30° TYP	- -	- -	30° TYP
L	0.185D	0.191D	- -	4.70	4.85	- -
M	- -	- -	1.250D	- -	- -	31.75D

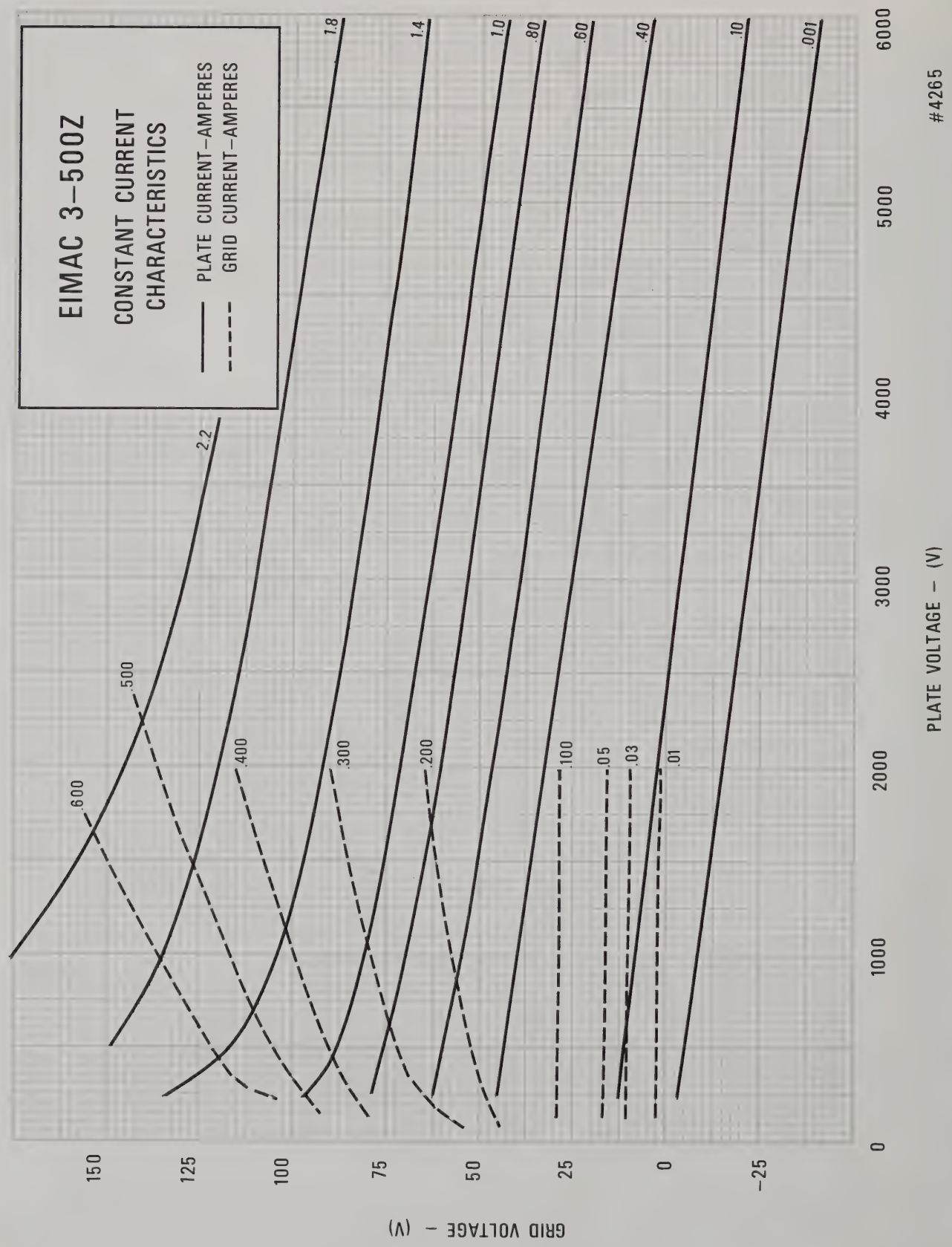
DIMENSIONAL DATA

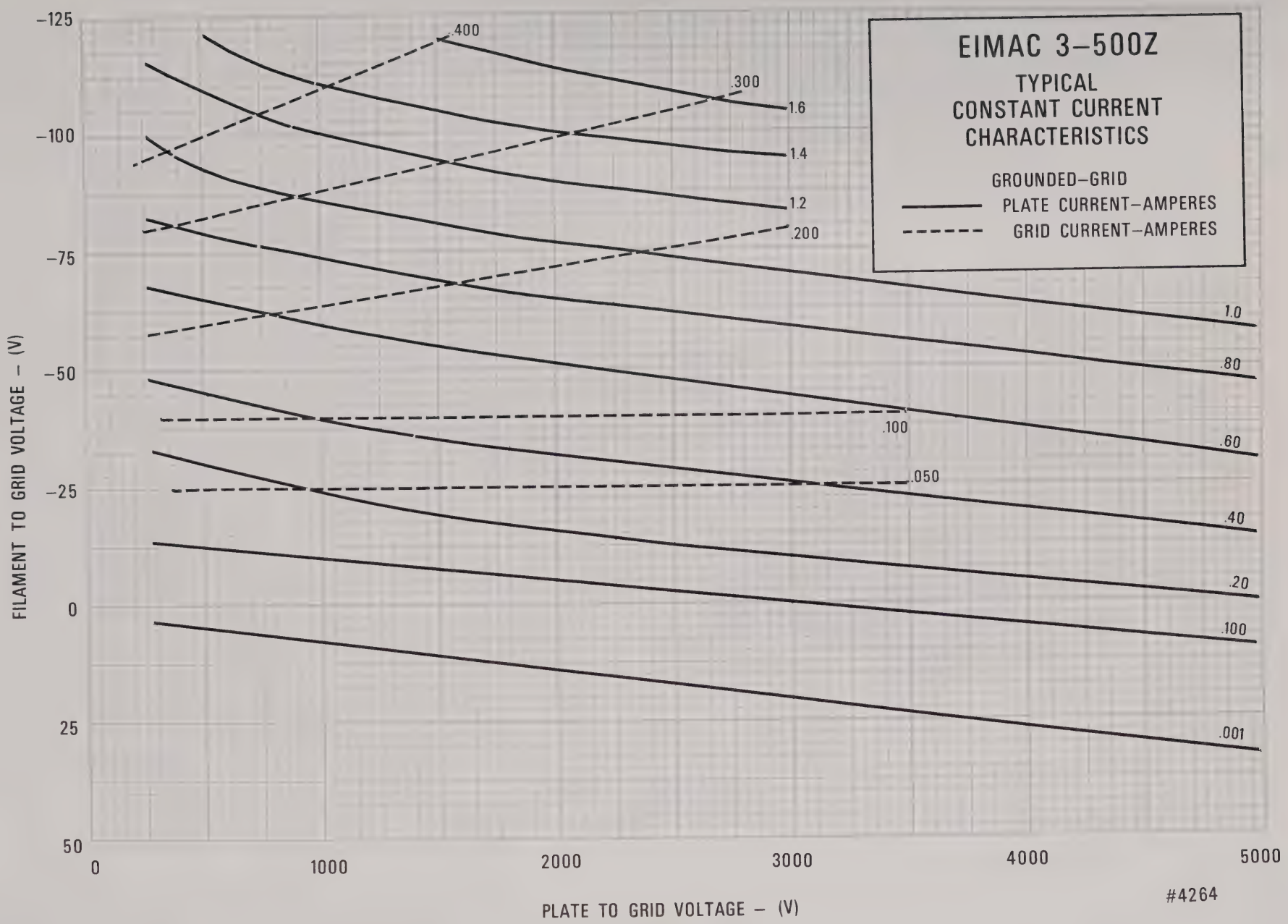
NOTE

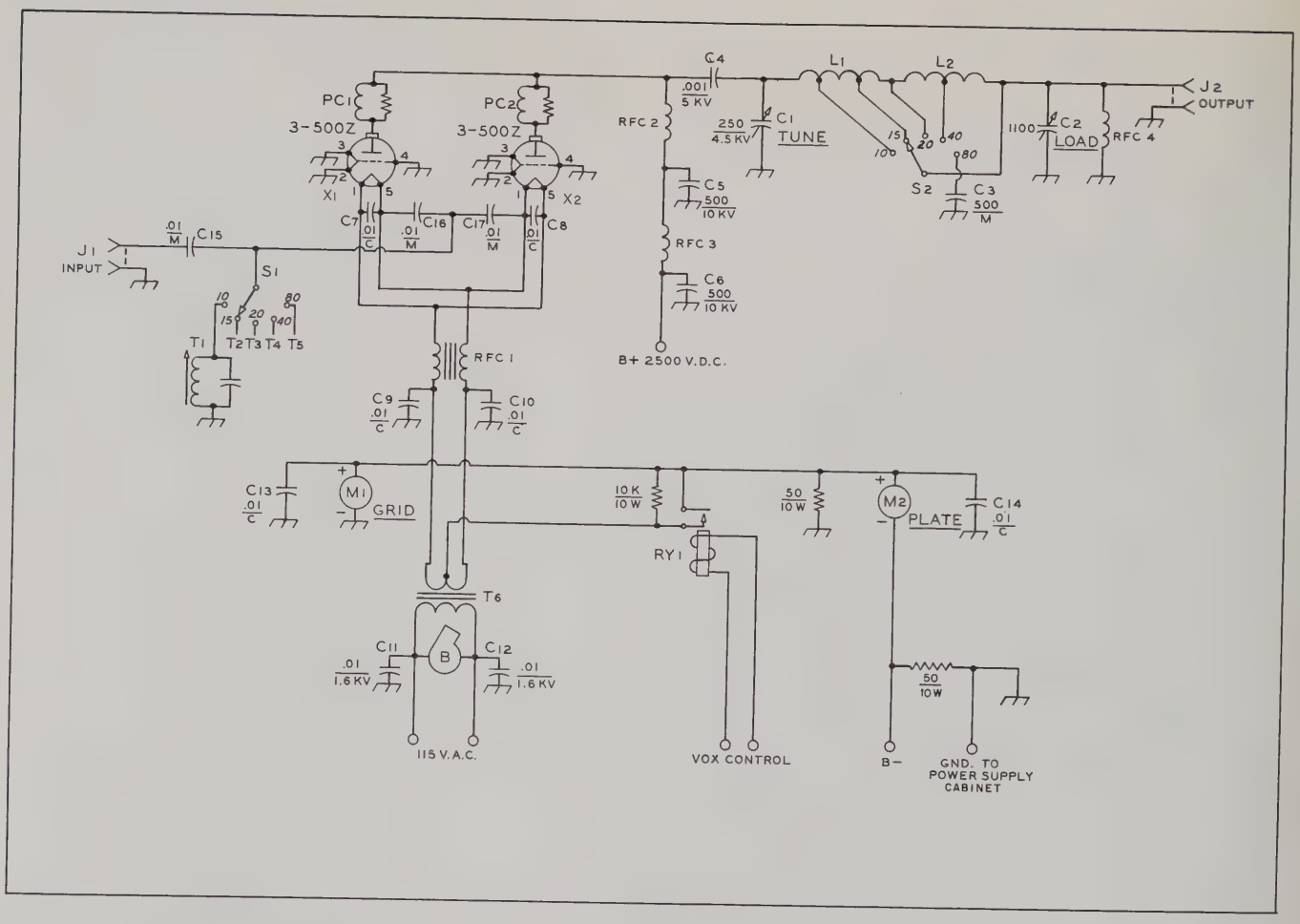
BASE PINS (L)
THEY CAN BE FREELY INSERTED INTO A GAUGE ¼" THICK WITH HOLE DIA'S OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMENSIONS (K) & (M).






EIMAC 3–500Z
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
2.2
1.8
1.4
1.0
.80
.60
.40
.10
.001
.500
.600
.400
.300
.200
.100
.05
.03
.01
150
125
100
75
50
25
0
–25
GRID VOLTAGE – (V)
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE – (V)
#4265


EIMAC 3–500Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
FILAMENT TO GRID VOLTAGE – (V)
PLATE TO GRID VOLTAGE – (V)
–125
–100
–75
–50
–25
0
25
50
0
1000
2000
3000
4000
5000
.400
.300
.200
.100
.050
1.6
1.4
1.2
1.0
.80
.60
.40
.20
.100
.001
#4264



TYPICAL CATHODE DRIVEN (GROUNDED GRID) AMPLIFIER CIRCUIT FOR TWO 3-500Z TUBES

C-1--250 pF, 4.5 kV (Johnson 154-16).

C-2--1100 pF, 3 section. Jackson Bros. LE-3-4595-380. (M. Swedgal, 258 Broadway, N.Y. 10007).

C-3--500 pF, 2.5 kV mica. Sangamo H-5347.

C-4--.001 μF, 5 kV. Centralab 858S-1000.

C-5, C-6--500 pF, 10 kV, TV "door knob" capacitor.

C-7 thru C-10--.01 μF, 600V ceramic capacitor (Centralab DD-103).

C-11, C-12--.01 μF, 1.6 kV ceramic capacitor (Centralab DD16-103).

C-13, C-14--.01 pF, 600V ceramic capacitor (Centralab DD-103).

C-15 thru C-17--.01 μF, 1 kV mica capacitor (Sangamo H-2210).

M-1--500 mAdc.

M-2--1000 mAdc.

RFC-1--50 μH. 14 bifilar turns #10 AWG enamelled wire wound on ferrite core, 5 inches long, ½ inch diameter. (Indiana General CF-503. Newark Electronics Co. catalog number 59F-1521). Notch core with file and break to length.

RFC-2--100 μH, 1 Adc. 112 turns #26 AWG, spacewound wire diameter on 1" diam., 6" long ceramic form (Centralab X-3022H insulator). Series resonant with terminals shorted to 24.5 MHz.

RFC-3--1.7 μH, 1 Adc. 20 turns #26 AWG wound on 100K, 2W resistor (J.W. Miller RFC-144).

RY-1--VOX operated SPST relay. Energized when transmit.

PC-1, PC-2--Three 100 ohm, 2W carbon resistors in parallel. Three turns #14 AWG, ½" diam., ¾" long in parallel with resistors. (Equivalent: Ohmite P-300 reduced to 3 turns).

J-1, J-2--Coaxial receptacle. UG-58A/U, for type N connector.

T-6--5 v at 30 amp. Chicago-Stancor P-4648.

X-1, X-2--EIMAC SK-410 socket and EIMAC SK-406 chimney.

B-Blower--13 cubic feet at 0.2 inch back pressure. Use #3 impeller at 3100 rpm. (Ripley 8472, Dayton 1C-180 or Redmond AK-2H-01AX).

CATHODE CIRCUIT COMPONENTS:

T-1 (10 meters)--0.15 μH. 4 turns #14 AWG on ½-inch form, ½-inch long. Parallel capacitance: 200 pF, 1 kV silver mica capacitor. Resonant at 28.7 MHz.

T-2 (15 meters)--0.15 μH, same as T-1. Resonant at 21.3 MHz with 470 pF, 1 kV silver mica capacitor.

T-3 (20 meters)--0.31 μH. 6 turns #14 AWG on ½-inch form, ½-inch long, slug tuned (National XR-50). Resonant at 14.2 MHz with 470 pF, 1 kV silver mica capacitor.

T-4 (40 meters)--0.31 μH, same as T-3. Resonant at 7.2 MHz with 940 pF. (Two 470 pF, 1 kV silver mica capacitors in parallel).

T-5 (80 meters)--1.3 μH. 13 turns #18 AWG on ½-inch diameter form, ½-inch long, slug tuned (National XR-50). Resonant at 3.8 MHz with 940 pF, same as T-4.

PLATE CIRCUIT COMPONENTS (for plate potential of 2500 Vdc), $R_L = 1725\Omega$:

The 10, 15 and 20 meter inductor (L_1) may be 10½ turns #8 AWG copper wire (or 3/16" tubing) 2" diam., 3" long. Ten meter tap is 5¼ turns from plate end; 15 meter tap is 7¼ turns from plate end. The 40-80 meter coil (L_2) may be 16 turns #10 AWG, 2½" diam., 4" long. Forty meter tap is 8 turns from junction with coil L-1.

S-2--Single pole ceramic switch, high voltage, 30° index. Radio Switch Corp. Model 86-A.

NOTE: For additional data on plate circuit design, write for Amateur Service Bulletin #30, "Pi and Pi-L Networks for Linear Amplifier Service"

NOTE: B- of power supply is floating and grounded only through plate meter M_2 and the 50 ohm safety resistor. Cabinet of power supply should be grounded to amplifier cabinet as safety measure.

TECHNICAL DATA

8242 / 3CW5000A3
8243 / 3CW5000F3
MEDIUM-MU WATER-COOLED POWER TRIODES

The EIMAC 8242/3CW5000A3 and 8243/3CW5000F3 are medium-mu water-cooled power triodes intended for use in amplifier, oscillator, or modulator service. Their maximum rated anode dissipation is 5000 watts. The two types are identical except for the addition of flexible leads for the grid and filament terminals of the 8243/3CW5000F3.

These tubes are water-cooled versions of the air-cooled 8161/3CX2500A3 and 8251/3CX2500F3.

The water-cooled tubes are recommended for industrial applications or installations where reserve anode dissipation is required.





GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten		
Voltage	7.5	V
Current @ 7.5 V (3CW5000A3)	51.5	A
(3CW5000F3)	50.5	A
Amplification Factor (Average)	22	
Transconductance (Average) (E_b = 3000 Vdc; I_b = 830 mAdc)	20,000	μmhos
Direct Interelectrode Capacitances (Cathode grounded)[2]		
Cin	35	pF
Cout	0.9	pF
Cgp	20	pF
Frequency of Maximum Ratings (CW)		
3CW5000A3 F1	75	MHz
F2	110	MHz
3CW5000F3 F1	30	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191.

(Revised 1-11-74) © 1962, 1964, 1967, 1974 by Varian

Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length (excluding leads on 3CW5000F3)	12.56 In; 31.9 Cm
Diameter	3.63 In; 9.22 Cm
Net Weight (Approximate) 3CW5000A3	4.8 lb; 2.2 kg
3CW5000F3	5.5 lb; 2.5 kg
Operating Position (both types)	Axis Vertical, Base Down or Up
Maximum Operating Temperatures:	
Ceramic/Metal Seals or Envelope	250°C
3CW5000F3 Filament Lead/Tube Base junctions	150°C
Cooling: Anode	Water or Equivalent Liquid
Envelope, Seals, Base Areas	Forced Air
Base: 3CW5000A3	Special Coaxial
3CW5000F3	Special with Flying Leads

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current @ 7.5 volts (3CW5000A3)	49.0	54.0	A
(3CW5000F3)	48.0	53.0	A
Interelectrode Capacitance (Grounded cathode) [1]			
Cin	29.2	40.2	pF
Cout	0.60	1.20	pF
Cgp	16.8	23.2	pF
Amplification Factor	19	26	

1. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association standard RS-191.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. This current variation causes no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM-Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (up to F1)	6000	VOLTS
DC PLATE VOLTAGE (F1 to F2)	4000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5000	WATTS
GRID DISSIPATION	150	WATTS

1. Approximate value.
2. Approximate; useful power delivered to the load will be lower because of circuit losses.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	4000	5000	6000	Vdc
Plate Current	2.5	2.5	2.1	Adc
Grid Voltage	-300	-450	-500	Vdc
Grid Current [1]	245	265	180	mAdc
Peak rf Grid Voltage [1]	580	750	765	v
Driving Power [1]	142	197	136	W
Grid Dissipation [1]	68	78	46	W
Plate Power Input	10	12.5	12.5	kW
Plate Dissipation	2.5	2.5	2.5	kW
Plate Power Output [2]	7.5	10	10	kW

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class C Telephony - Carrier Conditions

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (up to F1)	5000	VOLTS
DC PLATE VOLTAGE (F1 to F2)	3500	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	3350	WATTS
GRID DISSIPATION	150	WATTS

1. Approximate value.
2. Approximate; useful power delivered to the load will be lower because of circuit losses.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	4000	4500	5000	Vdc
Plate Current	1.67	1.55	1.45	Adc
Total Bias Voltage	-450	-500	-550	Vdc
Fixed Bias Voltage	-230	-325	-410	Vdc
Grid Resistor	1500	1500	1400	Ω
Grid Current	150	120	100	mAdc
Peak rf Grid Voltage[1]	680	720	760	v
Driving Power[1]	102	86	76	W
Grid Dissipation[1]	35	26	21	W
Plate Dissipation[1]	1.67	1.67	1.67	kW
Plate Power Output[2]	5.0	5.3	5.6	kW

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5000	WATTS
GRID DISSIPATION	150	WATTS

1. Approx. Adjust for specified zero-signal plate current.
2. Approximate.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	4000	5000	5000	6000	Vdc
Grid Voltage[1]	-145	-190	-190	-240	Vdc
Zero Signal Plate Current	0.6	0.5	0.5	0.4	Adc
Max. Signal Plate Current	2.70	2.26	3.2	3.0	Adc
Effective Load, plate-to-plate	3300	5000	3600	4650	Ω
Peak af Grid Voltage (per tube)[2]	285	310	360	390	v
Max. Signal Peak Driving Power[2]	134	118	230	225	W
Max. Signal Nom. Driving Power[2]	67	59	115	113	W
Max. Signal Plate Output Power[2]	7.4	8.0	11.0	13.0	kW

APPLICATION

MECHANICAL

MOUNTING - The 3CW5000A3 and 3CW5000F3 must be mounted vertically, base down or up at the convenience of the circuit designer. The filament connections to the 3CW5000A3 should be made through spring collets. These are available from EIMAC with the following part numbers:

149575 Inner line collet;
149576 Outer line collet

Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - With an anode dissipation of 5000 watts and with an incoming water temperature of 50°C maximum, 7.7 gpm of cooling water must be supplied to the anode cooling jacket. Outlet water temperature from the cooling jacket should never exceed 70°C, and water pressure on the jacket should not exceed 60 psi. The pressure drop across the anode cooling jacket itself, with a water flow of 7.7 gpm, will be approximately 6 psi. The grid-terminal contact surface and adjacent ceramic must be cooled by forced air, with quantity, velocity, and

direction adjusted to limit the maximum seal temperature to less than 250°C.

The filament stem structure also requires forced-air cooling. A minimum of 6 cfm should be directed into the space between the inner and outer filament contacting surfaces.

Both air and water flow must be supplied before or simultaneously with the application of electrode voltages, including the filament, and may be removed simultaneously with them. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

ELECTRICAL

FILAMENT OPERATION - The filament voltage, as measured at the filament terminals, should be 7.5 volts, with maximum allowable variations due to line fluctuations of from 7.12 to 7.87 volts.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

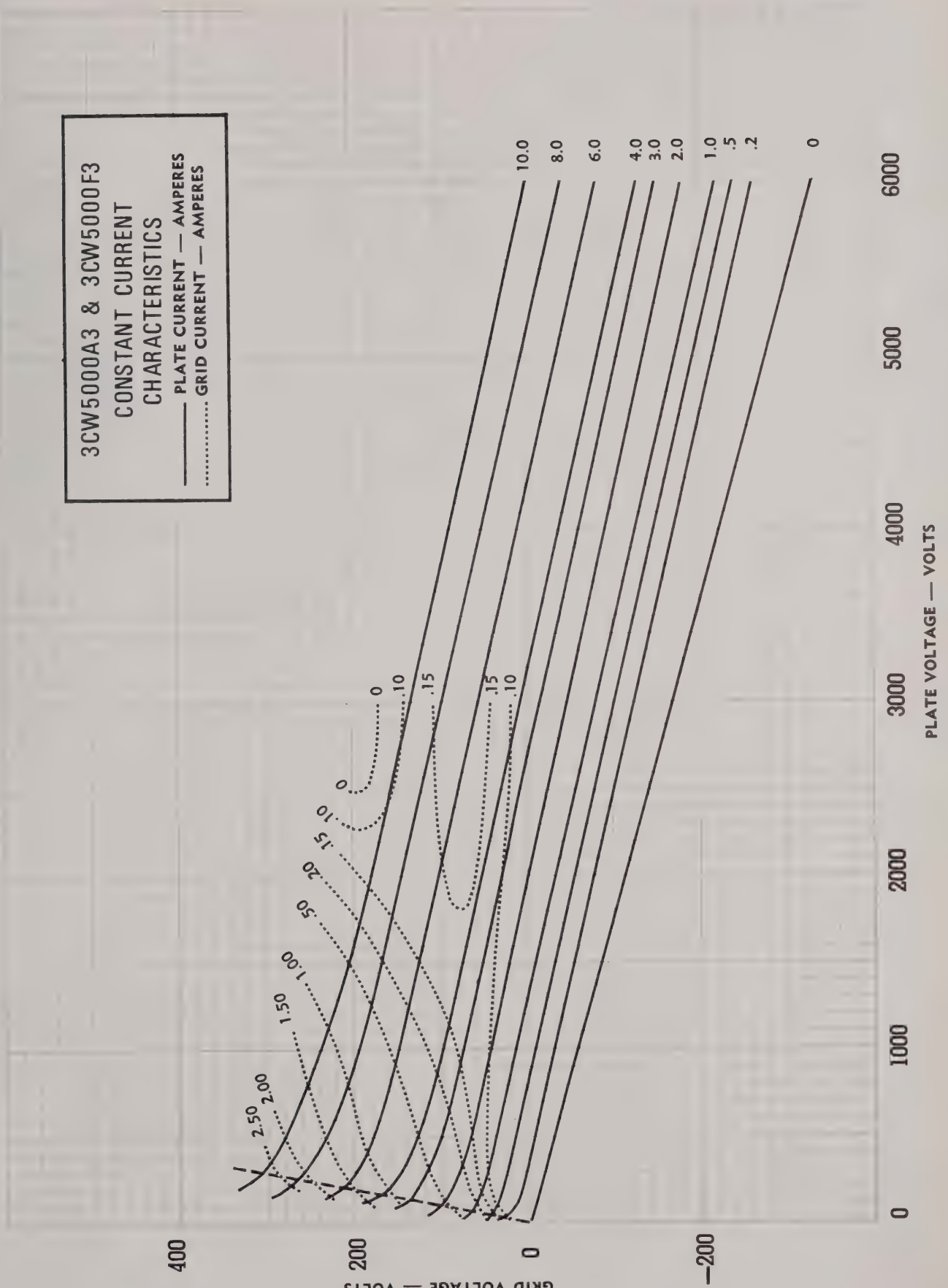
Many EIMAC power tubes, such as these, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

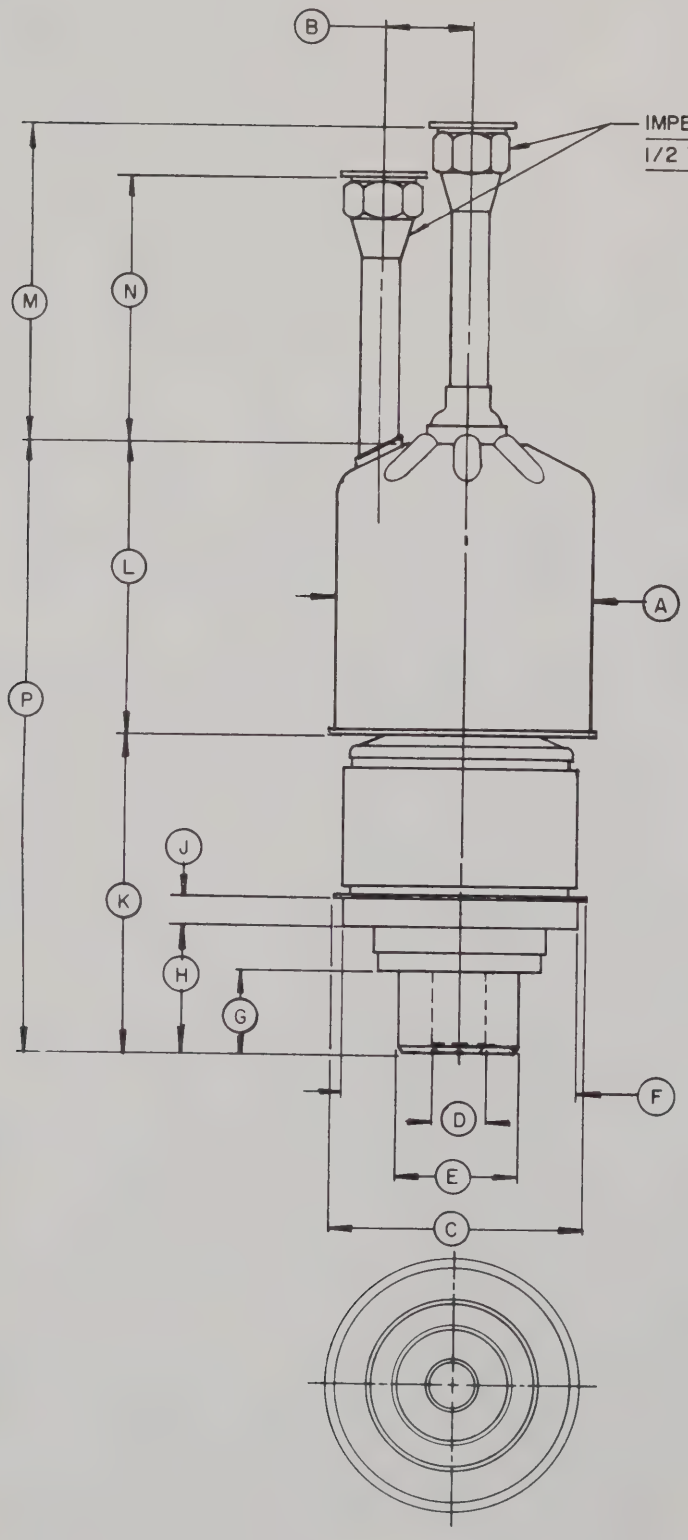
HIGH VOLTAGE - Normal operating voltages used with these tubes are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

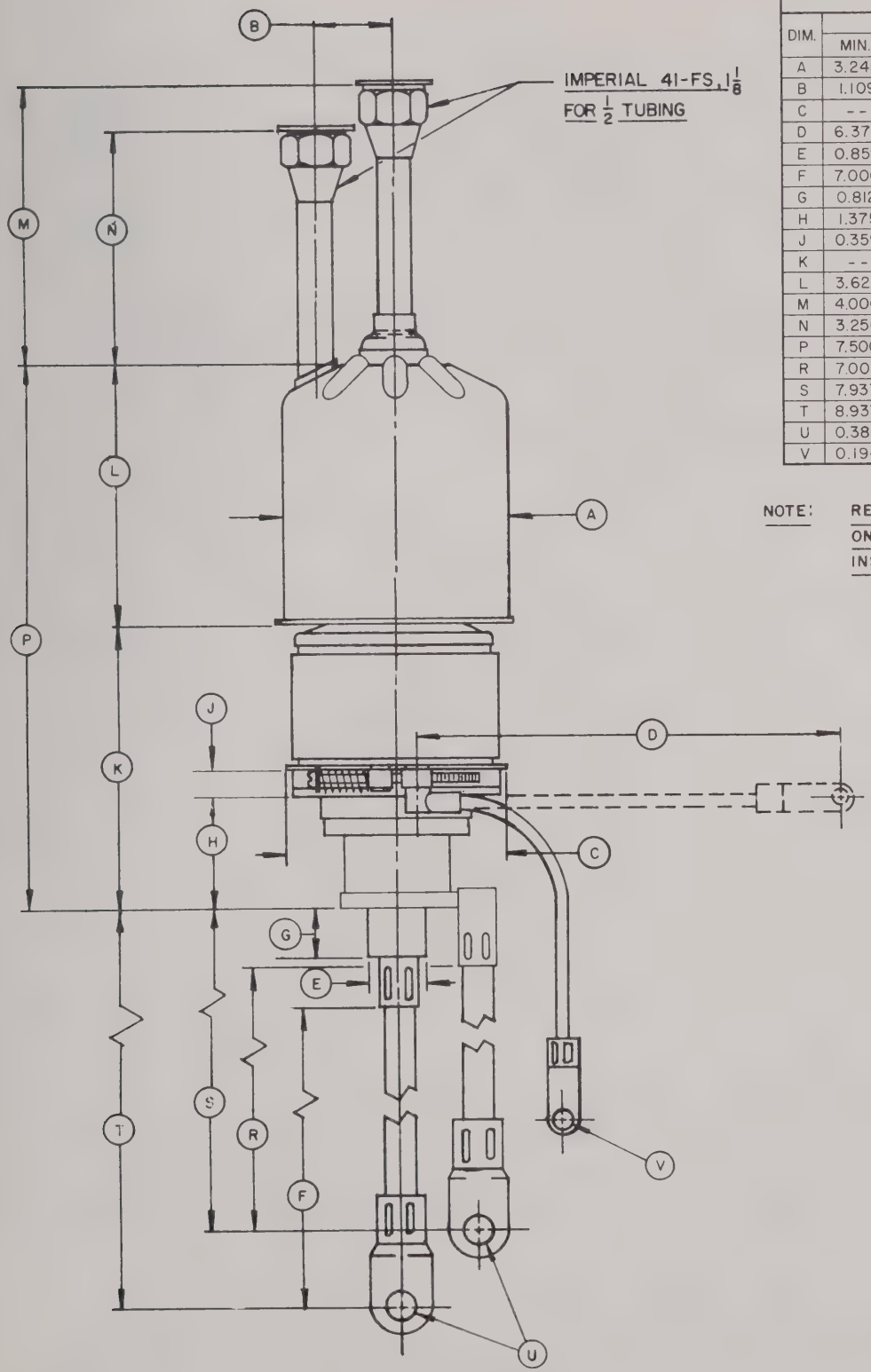
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


3CW5000A3 & 3CW5000F3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
400
200
0
—200
GRID VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	--	82.42	82.68	--
B	1.109	1.141	--	28.17	28.98	--
C	--	3.625	--	--	92.08	--
D	0.615	0.635	--	15.62	16.13	--
E	1.490	1.510	--	37.85	38.35	--
F	2.990	3.010	--	75.95	76.45	--
G	0.812	0.938	--	20.62	23.83	--
H	1.375	1.625	--	34.93	41.28	--
J	0.359	0.422	--	9.12	10.72	--
K	--	--	3.599	--	--	91.41
L	3.625	3.875	--	92.08	98.43	--
M	4.000	4.500	--	101.60	114.30	--
N	3.250	3.750	--	82.55	95.25	--
P	7.500	8.125	--	190.50	206.38	--

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	--	82.42	82.68	--
B	1.109	1.141	--	28.17	28.98	--
C	--	3.625	--	--	92.08	--
D	6.375	6.625	--	161.93	168.28	--
E	0.859	0.890	--	21.82	22.61	--
F	7.000	7.500	--	177.80	190.50	--
G	0.812	0.938	--	20.62	23.83	--
H	1.375	1.625	--	34.93	41.28	--
J	0.359	0.422	--	9.12	10.72	--
K	--	--	3.599	--	--	91.41
L	3.625	3.875	--	92.08	98.43	--
M	4.000	4.500	--	101.60	114.30	--
N	3.250	3.750	--	82.55	95.25	--
P	7.500	8.125	--	190.50	206.38	--
R	7.000	7.500	--	177.80	190.50	--
S	7.937	8.437	--	201.60	214.30	--
T	8.937	9.437	--	226.99	239.70	--
U	0.385	0.395	--	9.78	10.03	--
V	0.194	0.200	--	4.93	5.08	--

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.

TECHNICAL DATA

8877
3CX1500A7

HIGH-MU
POWER TRIODE

The EIMAC 8877/3CX1500A7 is a rugged ceramic/metal power triode designed for use as a cathode driven Class AB_2 or Class B amplifier, in audio or rf applications including the UHF band, or as a cathode driven plate modulated Class C rf amplifier. As a linear amplifier, high power gain may be obtained without sacrifice of low intermodulation characteristics.



Low grid interception and high amplification factor combine to make the 8877/3CX1500A7 drive power requirements exceptionally low for a tube of this power capacity.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.0 ± 0.25	V
Current, at 5.0 volts	10.5	A
Transconductance (Average):		
I_b = 1.0 Adc	55,000	μmhos
Amplification Factor (Average)	200	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	38.5	pF
Cout	0.1	pF
Cgp	10	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	38.5	pF
Cout	10	pF
Cpk	0.1	pF
Ck-htr	17.0	pF
Frequency of Maximum Rating:		
CW	250	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Revised 8-1-73) © 1970, 1971, 1973 by Varian

Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.02 in;102.16 mm
Diameter	3.38 in; 85.85 mm
Net Weight	25.0 oz; 708.8 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals, Anode Core	250°C
Cooling	Forced Air
Base	Special 7-pin
Recommended Air System Socket	
(Grounded Grid)	SK-2210
(Grounded Cathode)	SK-2200
Recommended Air Chimney	
(Fiberglass)	SK-2206
(Teflon)	SK 2216

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.0 volts	9.5	11.5	A
Cathode Warmup Time	90	---	sec
Interelectrode Capacitance (grounded grid circuit)[1]			
Cin	36.0	41.0	pF
Cout	9.2	11.2	pF
Cpk	---	0.2	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN Class AB_2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2 Cathode Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2700	3500	Vdc
Cathode Voltage[1]	+8.2	+8.2	Vdc
Zero-Signal Plate Current[3]	92	182	mAdc
Single-Tone Plate Current	740	1000	mAdc
Two-Tone Plate Current	480	675	mAdc
Single-Tone Grid Current[3]	40	74	mAdc
Two-Tone Grid Current[3]	16	25	mAdc
Peak rf Cathode Voltage[3]	68	81	v
Peak Driving Power[3]	40	64	w
Single-Tone Useful Output Power[3]	1085	2075	W
Resonant Load Impedance	1820	2000	Ω
Intermodulation Distortion Products[2]			
3rd Order	-40	-38	dB
5th Order	-41	-41	dB

1. Positive cathode bias provided by zener diode.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (220 MHz)
Class AB_2 Cathode Driven

Plate Voltage	2500	Vdc
Cathode Voltage[1]	+8.2	Vdc
Plate Current	1000	mAdc
Grid Current[2]	10	mAdc
Useful Output Power[2]	1520	W
Driving Power[2]	57	W
Power Gain[2]	14	dB

1. Positive cathode bias provided by zener diode.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class B Telegraphy or FM
(Continuous Operating Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (88-108 MHz) Measured Values
Class B, Cathode Driven

Plate Voltage	2000	2500	3000	4000	Vdc
Cathode Voltage[1,2]	+9	+12	+15	+20	Vdc
Plate Current	1.0	1.0	1.0	1.0	Adc
Grid Current[2]	60	58	42	25	mAdc
Driving Power[2]	64	54	65	78	W
Useful Power Output[3]	1330	1670	1960	2600	W
Efficiency[4]	66.5	66.7	65.5	65.2	%
Power Gain[4]	13.2	14.2	14.8	15.3	dB

1. For measured case, idling anode current was set for 10 mAdc.
2. Approximate.
3. Approximate, delivered to the load.
4. For the measured case; may vary from tube to tube.

RADIO FREQUENCY POWER AMPLIFIER

Class C - Cathode Driven, Plate Modulated

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3200	VOLTS
DC PLATE CURRENT	0.8	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION Carrier Conditions, Frequencies to 30 MHz, Cathode Driven

Plate Voltage	2400	Vdc
Cathode Voltage[1]	+22	Vdc
Plate Current	600	mAdc
Grid Current[2]	45	mAdc
Plate Load Resistance	2000	Ω
Driving Power[3]	41	W
Plate Output Power	1000	W
Power Gain	14	dB

1. Bias may be obtained from a fixed supply of 15.8 volts in series with a 9.5 ohm resistor. The resistor & supply should be bypassed for audio frequencies.
2. Approximate.
3. Approximate, and driver must be modulated approximately 83%.

APPLICATION

MECHANICAL

MOUNTING - The 8877/3CX1500A7 may be mounted in any position.

SOCKET - The grid of the 8877/3CX1500A7 terminates in the cylindrical grid ring about the base of the tube. This may be contacted by multiple clips or flexible finger stock. Connections to the heater and cathode are made via the 7-pin base.

COOLING - The maximum temperature limit for external tube surfaces and the anode core is 250°C. Tube life is prolonged if these areas are maintained at lower temperatures. For full 1500 watt anode dissipation 38.0 cfm of air is required at a back pressure of 0.60 inches to hold tube temperature below 225°C with 50°C ambient temperature at sea level. At frequencies higher than 30 MHz, or at high altitudes, the air quantity must be increased.

Base-to-Anode Air Flow (sea level)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H 0
500	7.7	0.10
1000	20.3	0.23
1500	38.0	0.60
Base-to-Anode Air Flow (10,000 ft.)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H 0
500	11.2	0.15
1000	29.5	0.34
1500	55.5	0.88

Note: 1) Tube mounted in SK-2200 Socket with SK-2216 Chimney.
2) An allowance of 25 watts has been made for grid dissipation and 50 watts for filament power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8877/3CX1500A7 is 5.0 volts. Filament voltage, as measured at the socket optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 8877/3CX1500A7 is operated as a cathode driven rf amplifier, the use of a resonant circuit in the cathode is recommended. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of two or more.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate potentials over 3000 volts, since plate dissipation may be exceeded. Higher plate voltage may be used with the proper protective bias.

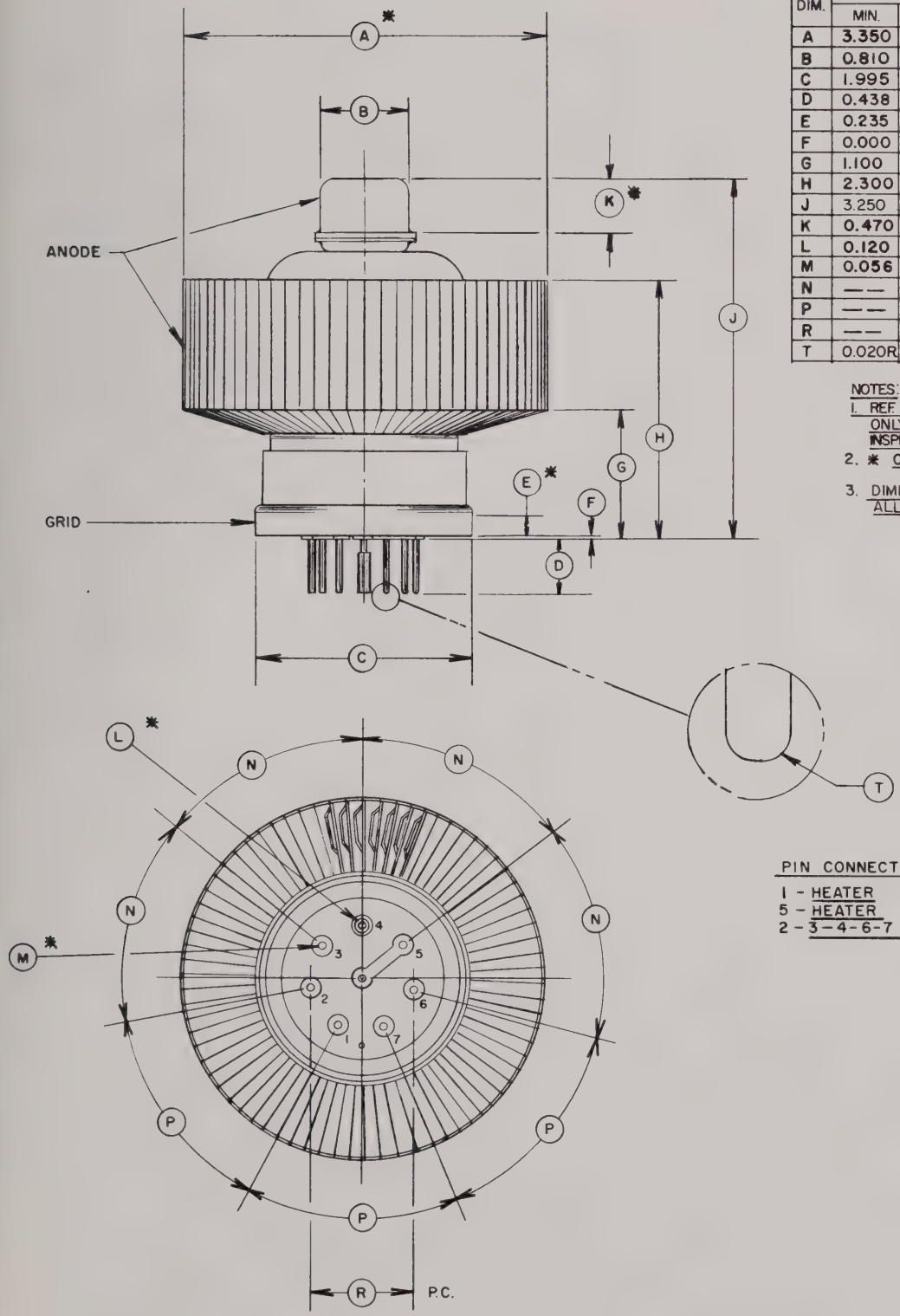
HIGH VOLTAGE - The 3CX1500A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

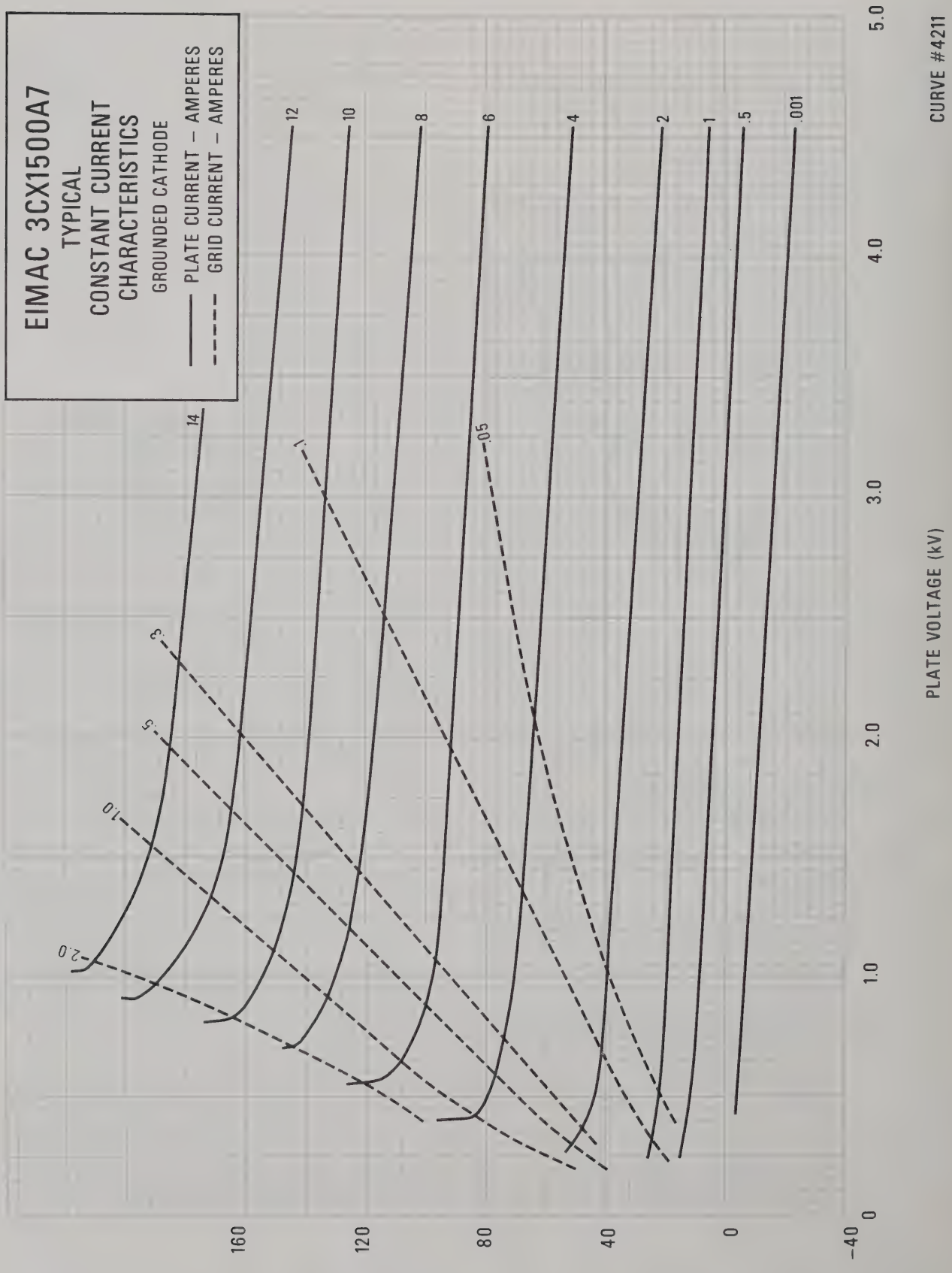


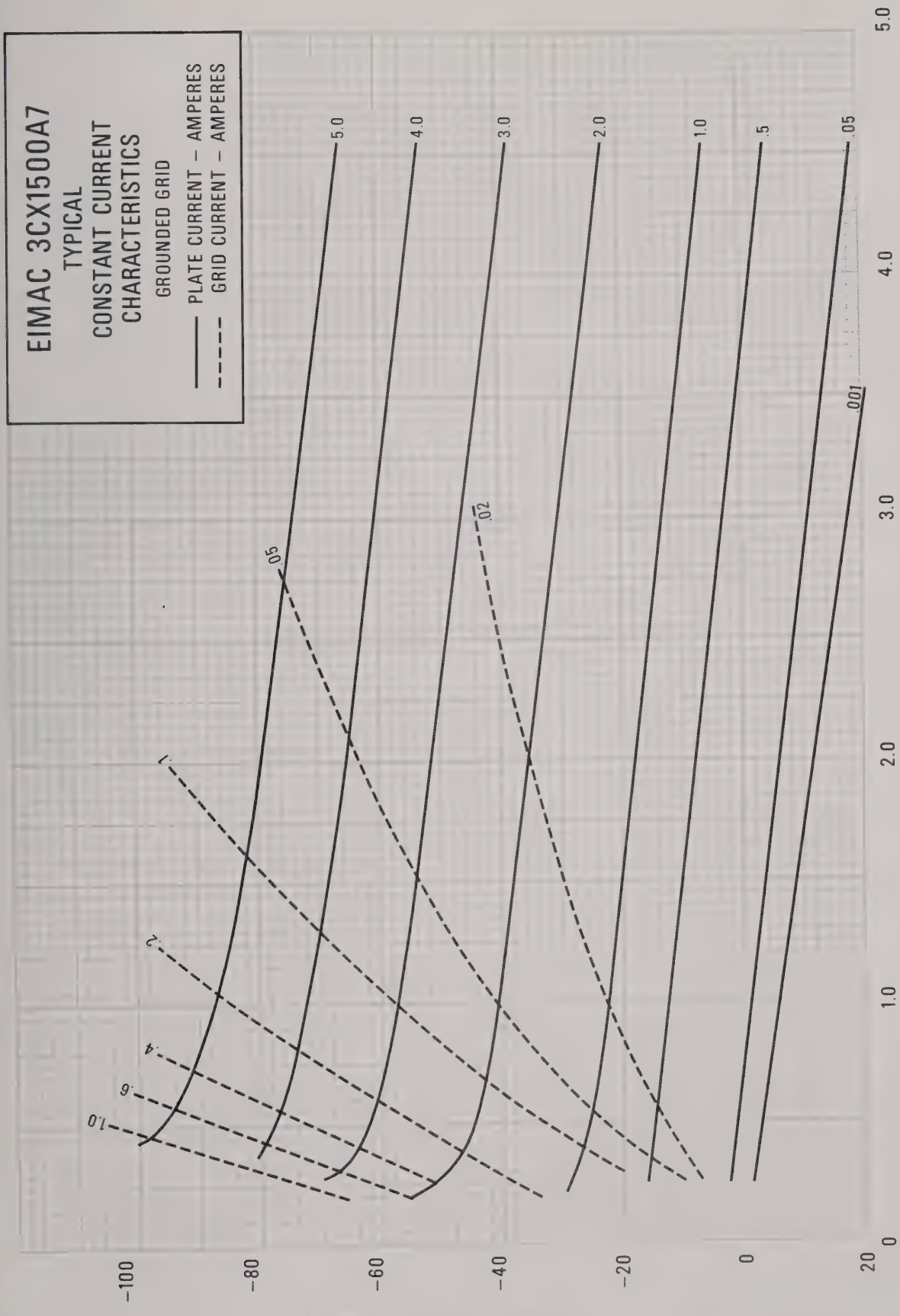
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.350	3.380	— —	85.09	85.85	— —
B	0.810	0.820	— —	20.57	20.83	— —
C	1.995	2.015	— —	50.67	51.18	— —
D	0.438	0.562	— —	11.13	14.27	— —
E	0.235	— —	— —	5.97	— —	— —
F	0.000	0.040	— —	0.00	1.02	— —
G	1.100	1.225	— —	27.94	31.12	— —
H	2.300	2.425	— —	58.42	61.60	— —
J	3.250	3.420	— —	82.55	86.87	— —
K	0.470	0.530	— —	11.94	13.46	— —
L	0.120	0.127	— —	3.05	3.23	— —
M	0.056	0.062	— —	1.42	1.57	— —
N	— —	— —	51°	— —	— —	51°
P	— —	— —	52°	— —	— —	52°
R	— —	— —	1.000	— —	— —	25.40
T	0.020R	— —	— —	0.51R	— —	— —

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. ✱ CONTACT SURFACE
3. DIMENSION T APPLIES TO ALL BUT CENTER PIN.

PIN CONNECTIONS

1 - HEATER
5 - HEATER
2 - 3-4-6-7 CATHODE


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
14
12
10
8
6
4
2
1
.5
.001
.05
.1
.3
.5
1.0
2.0
GRID VOLTAGE (V)
160
120
80
40
0
–40
0
1.0
2.0
3.0
4.0
5.0
PLATE VOLTAGE (kV)
CURVE #4211


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
5.0
4.0
3.0
2.0
1.0
.5
.05
.001
.05
.02
1.0
.6
.4
.2
CATHODE TO GRID VOLTAGE (V)
−100
−80
−60
−40
−20
0
20
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (KV)
CURVE #4250

3CX20,000A7

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 3CX20,000A7 is a ceramic/metal power triode intended for use as a zero-bias Class B rf amplifier or Class C power amplifier or oscillator. Class B operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3CX20,000A7.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	160	A
Amplification Factor (Average):	200	
Direct Interelectrode Capacitance (grounded cathode) [2]		
Cin	61.0	pF
Cout	0.2	pF
Cgp	36	pF
Direct Interelectrode Capacitance (grounded grid) [2]		
Cin	61.0	pF
Cout	36	pF
Cpk	0.2	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:	
Length	8.50 in; 215.9 mm
Diameter	8.25 in; 209.6 mm
Net Weight	13.5 lb; 6.15 kg
Operating Position	Vertical base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C

(Effective 7-1-73) © 1972 by Varian Printed in U.S.A.

Cooling	Forced air
Base	Coaxial
Recommended Air System Socket	SK-1300 or SK-1320

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate values.
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB_2

Plate Voltage	7000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current[1]	.6	.6	Adc
Single-Tone Plate Current[2]	5.92	5.0	Adc
Single-Tone Grid Current[1]	1.22	1.0	Adc
Driving Power[1]	1750	1540	W
Plate Dissipation	13.4	10.8	kW
Single-Tone Plate Output Power	29.6	24.2	kW
Resonant Load Impedance	693	745	Ω
Drive Impedance	27	32	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7000	Vdc
Grid Voltage	-230	Vdc
Plate Current	4.0	Adc
Grid Current[1]	775	mAdc
Peak rf Grid Voltage[1]	555	v
Calculated Driving Power[1]	430	W
Plate Input Power	28	kW
Plate Dissipation	6.7	kW
Plate Output Power	21.3	kW
Resonant Load Impedance	963	Ω

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class C Cathode Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

Plate Voltage	7200	7800	Vdc
Grid to Cathode Voltage	-200	-200	Vdc
Plate Current	3.7	4.2	Adc
Grid Current[1]	92	98	mAdc
Peak rf Cathode Voltage[1]	480	500	v
Cathode Driving Power[1]	1900	2300	W
Plate Dissipation	4500	5000	kW
Plate Load Resistance	1080	1020	Ω
Plate Output Power	22.0	27.5	kW

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class B Television Service, Cathode Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 216 MHz)
Class B

Plate Voltage	7200 Vdc
Grid Voltage	0 Vdc
Zero Signal Plate Current[1]	1.2 Adc
Effective rf Load Resistance	605 Ω
Plate Current: Blanking Level	4.8 Adc
Sync. Peak Level	5.8 Adc
Grid Current: Blanking Level[1]	0.47 Adc
Sync. Peak Level[1]	1.14 Adc
rf Cathode Voltage Peak:	
Blanking Level[1]	230 v
Sync. Peak Level[1]	300 v
Driving Power: Blanking Level[1]	690 w
Sync. Peak Level[1]	1700 w
Plate Power Output: Blanking Level	16.5 kw
Sync. Peak Level	27.5 kw

1. Approximate value.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid) [1]			
Cin	55.0	67.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode) [1]			
Cin	55.0	67.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - The 3CX20,000A7 must be operated vertically, base up or down, and should be protected from severe shock and vibration. The use of an EIMAC air-system socket is recommended. For grid-driven applications, the SK-1300 is used; for cathode-driven circuits, the SK-1320 should be used, as the grid is grounded to the socket frame in this unit.

COOLING - The maximum temperature rating for the external surfaces of the 3CX20,000A7 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the anode core and the ceramic/metal seals below the maximum rating. Air flow should be applied before or simultaneously with the application of electrode voltages (including the filament) and should normally be maintained for a short period of time after all voltages are removed to allow for tube cool-down.

Minimum air flow requirements (for air flowing in a base to anode direction) to maintain core and seal temperatures below 225°C with an inlet temperature of 50°C are tabulated here. Pressure drop for this tabulation is measured across the anode cooler and does not include drop across a socket or chimney. In cases where the tube base is not directly in the anode cooling air stream, provision should be made to direct an air stream of at least 50 CFM at the base from a 1-1/2 inch nozzle, or make other provision to conduct heat from the filament and grid terminals.

Anode Dissipation * kW	Sea Level		10,000 Feet Alt.	
	Air Flow CFM	Pressure Drop In. Water	Air Flow CFM	Pressure Drop In. Water
7.5	122	.25	203	.45
10.0	241	.70	350	1.00
12.5	400	1.40	580	2.25
15.0	590	2.45	940	3.90
17.5	840	4.25	1320	6.70
20.0	1180	6.90	1710	10.00

* Since the power dissipated by the filament is about 1000 watts, and since the grid dissipation can represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1500 watts of dissipation.

FILAMENT OPERATION - The rated filament voltage for the 3CX20,000A7 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INPUT CIRCUIT - When the 3CX20,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of two or more.

CLASS-C OPERATION - Although specifically designed for Class-B service, the 3CX20,000A7 may be operated as a Class-C power amplifier or oscillator. The zero-bias characteristic of the 3CX20,000A7 can be used to advantage in Class-C amplifiers by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

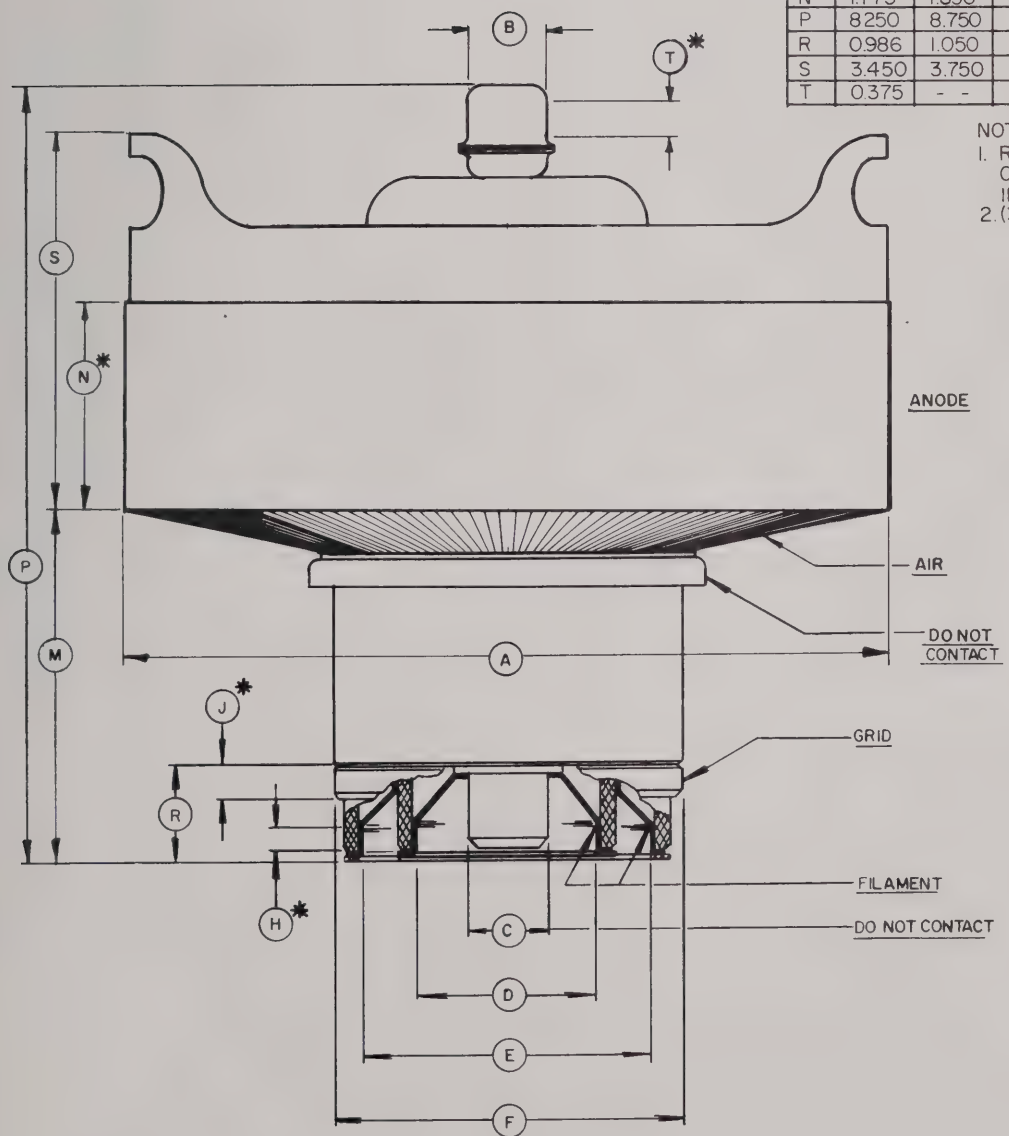
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

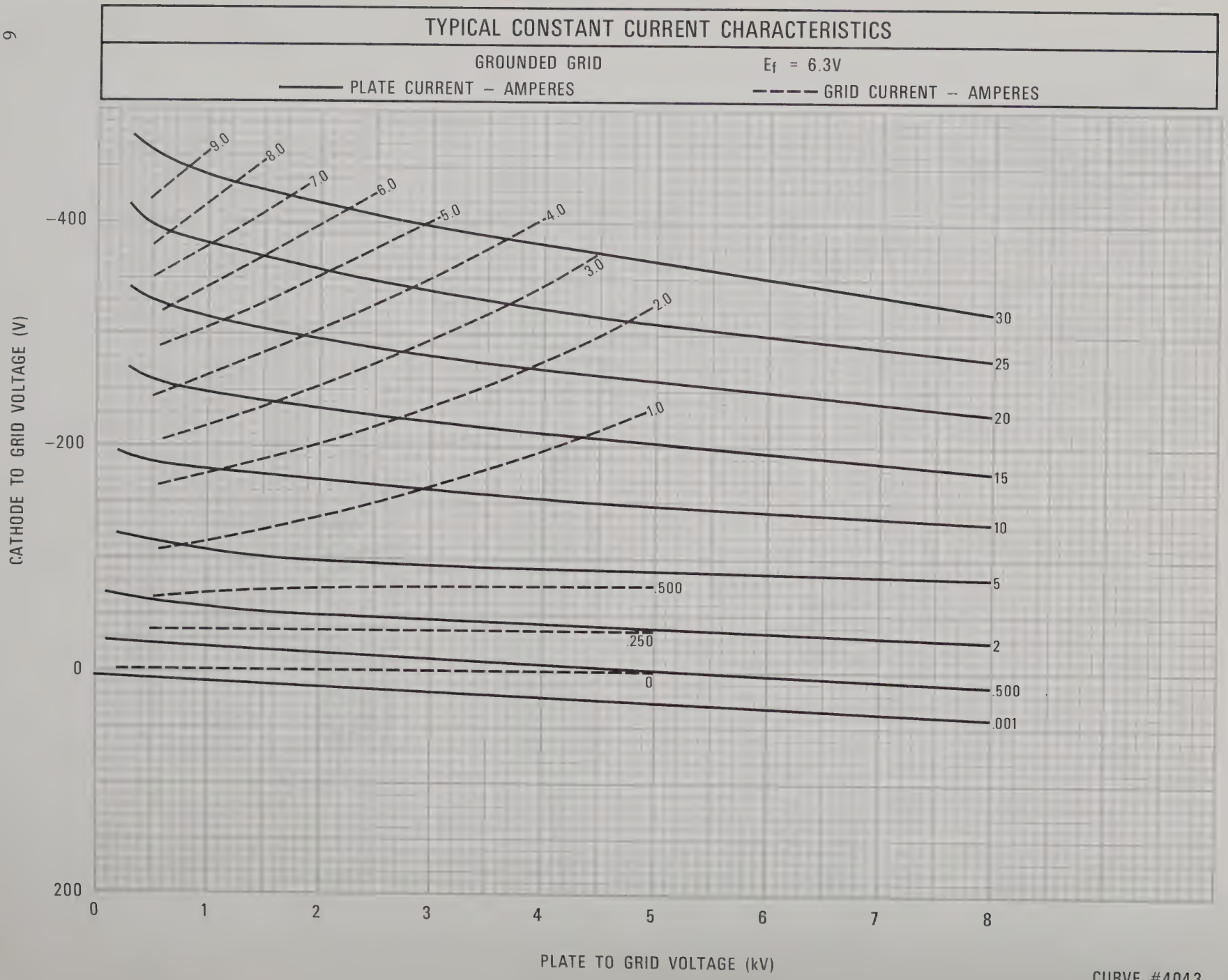
HIGH VOLTAGE - The 3CX20,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

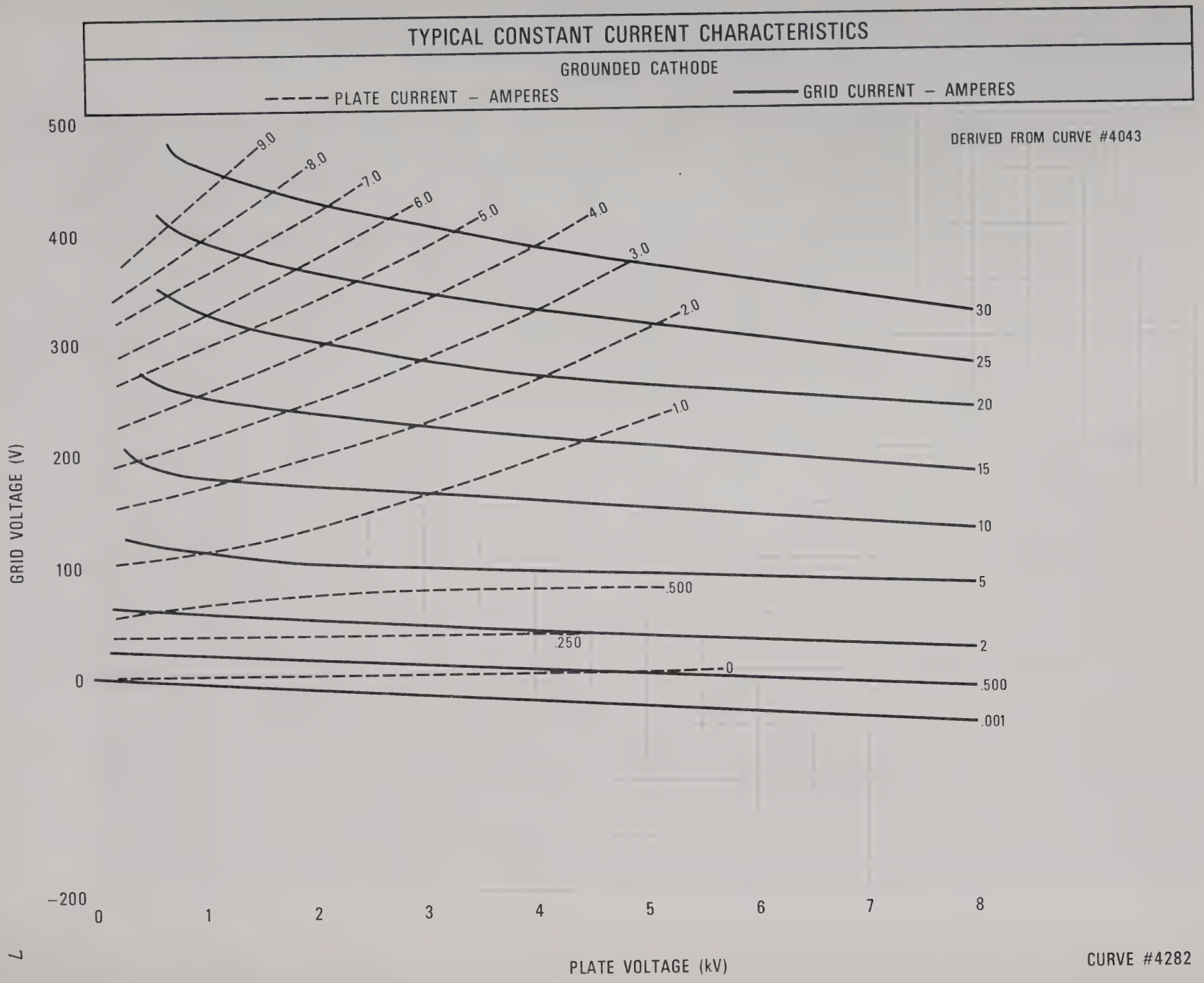
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	8.190	8.310	- -	208.03	211.07	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	4.125	4.375	- -	104.77	111.12	- -
N	1.775	1.850	- -	45.08	46.99	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.450	3.750	- -	87.63	95.25	- -
T	0.375	- -	- -	9.52	- -	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES
2. (✱) CONTACT SURFACES




TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
Ef = 6.3V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
–400
–200
0
200
0
1
2
3
4
5
6
7
8
PLATE TO GRID VOLTAGE (kV)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
30
25
20
15
10
5
2
.500
.001
CURVE #4043


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
DERIVED FROM CURVE #4043
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
500
400
300
200
100
0
−200
0
1
2
3
4
5
6
7
8
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
30
25
20
15
10
5
2
.500
.001

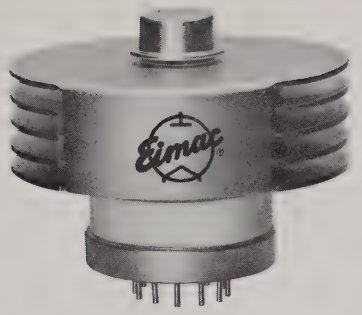
CURVE #4282

TECHNICAL DATA

8873
8874
8875
HIGH-MU
TRIODES


8873


8874


8875

The EIMAC 8873, 8874, and 8875 are compact external-anode, ceramic/metal triodes intended for use in zero-bias Class-B amplifiers in audio or radio-frequency applications. The three types differ only in method of cooling and anode dissipation: the anode of the 8873 is designed for conduction cooling and is nominally rated for 200 watts; the 8875 anode has a transverse cooler for forced-air cooling and is rated for 300 watts; and the 8874 requires axial-flow forced-air cooling and is rated for 400 watts. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with these types in a cathode-driven circuit.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater Voltage	6.3 ± 0.3 V
Heater Current, at 6.3 volts	3.0 A
Cathode-Heater Potential (maximum)	±150 V
Transconductance, average	
I_b = 250 mAdc	29,000 μmhos
Amplification Factor, average	240
Direct Interelectrode Capacitances, (cathode grounded, in shielded fixture) [2]	
Cin	20.5 pF
Cout	0.03 pF
Cgp	6.0 pF
Direct Interelectrode Capacitances, (grid grounded, in shielded fixture) [2]	
Cin	20.5 pF
Cout	6.0 pF
Cpk	0.03 pF
Ck-htr	6.0 pF
Frequency of Maximum Rating:	
CW	500 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Stantard RS-191.

(Revised 6-3-73) © 1970, 1971, 1973 by Varian

Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:

	TYPE 8873	TYPE 8874	TYPE 8875
Length	2.14 in. 54.41 mm	2.14 in. 54.41 mm	2.18 in. 55.50 mm
Diameter	1.64 in. 41.66 mm	1.64 in. 41.66 mm	2.52 in. 64.01 mm
Net Weight	8.5 oz. 240.9 gm	4.3 oz. 121.9 gm	8.6 oz.243.8 gm
Operating Position	Any	Any	Any

Cooling:(Type 8873)

Conduction cooled. Recommended Beryllium Oxide thermal link ..... EIMAC SK-1920

(Type 8874)

Air flow at 50°C and sea level ..... 8.6 ft^3/Min.

Pressure Drop, across tube anode cooler at 8.6 ft^3/Min. ..... 0.37 in. H_2O

(Type 8875)

Air flow at 25°C and sea level, and
Pressure Drop across tube anode cooler } See Application Section, Cooling 8875

Operating Temperature, Maximum, all three types,

Ceramic/Metal seals and Anode Core ..... 250°C

Base: (all types) ..... Large Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)

Recommended Sockets ..... E.F. Johnson #124-311-100

Erie #9802-000

Mycalex #CP464-2

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	2.8	3.4	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitances (cathode grounded, in shielded fixture) [1]			
Cin	18.0	23.0	pF
Cout	---	0.04	pF
Cgp	5.0	7.0	pF
Interelectrode Capacitances (grid grounded, in shielded fixture) [1]			
Cin	18.0	23.0	pF
Cout	5.0	7.0	pF
Cpk	---	0.04	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION

Class AB_2 (Cathode driven) Peak Envelope Modulation Crest or Key-Down Conditions[1]

Frequency	30	150	432	MHz
Plate Voltage	2000	2000	2000	Vdc
Cathode Voltage	8.2	9.8	8.2	Vdc
Zero-Signal Plate Current	22	10	22	mAdc
Single-Tone IVS Plate Current[2]	500	400	500	mAdc
Two-Tone Plate Current[3]	312	245	300	mAdc
Single-Tone Grid Current[4]	30	23	98	mAdc
Two-Tone Grid Current[4]	12	10	39	mAdc
Peak rf Grid/Cathode Voltage[4]	67	50	67	v
Peak Driving Power[4]	26	17.5	27	w
Peak Power Input	1000	800	1000	w
Useful Output Power[4]	587	526	505	W
Resonant Load Impedance	2140	--	--	Ω
Intermodulation Distortion[5]				
3rd Order	-35	--	--	dB
5th Order	-36	--	--	dB

1. Short-term duty should not exceed 50%. During brief test periods, "on" time must be kept as short as possible, with sufficient "off" time to allow for tube cooling.
2. Key down conditions. With 50% duty, current will be half the value shown.
3. Two equal-tone modulation. During brief test periods, allow sufficient "off" time for tube cooling. Values will be lower with voice modulation for the same PEP level.
4. Approximate values.
5. The intermodulation distortion products are referenced against one tone of a two equal-tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	2000	Vdc
Grid Voltage[1]	-10	Vdc
Plate Current	250	mAdc
Grid Current[1]	40	mAdc
Measured Driving Power	9	W
Plate Input Power	500	W
Plate Dissipation	195	W
Useful Output Power	305	W

1. Approximate value.

PULSE MODULATOR OR REGULATOR

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4500	VOLTS
PEAK ANODE CURRENT	6	AMPERES
GRID DISSIPATION	5	WATTS
PLATE DISSIPATION (nominal values):		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS

APPLICATION

MOUNTING & SOCKETING - The 8873, 8874, and 8875 may be mounted in any position. Sockets such as E.F. Johnson #124-311-100, Erie #9802-000, Mycalex # CP464-2, or equivalent may be used as long as there are no unusual circumstances which would allow the ceramic/metal anode and base seal temperatures to exceed 250°C. The internal construction of these tubes is such that heat transfer to the tube base is minimized, but in operation there is some heat flow from the tube base to the socket. Mounting should be such that free movement of air past the base by convection is possible, or, if forced-air cooling is being provided for the anode, some of this air may be bled off to provide for some circulation past the tube base.

The 8873 mounting is normally controlled by its heat sink configuration and location. Where possible, the socket can be mounted on a bracket which in turn is mounted to the heat sink so that the one sink will act for removal of heat from the tube anode and also the tube base. The EIMAC SK-1920 beryllium oxide (BeO) thermal link is available for use between the 8873 anode and the heat sink. BeO is a ceramic material which exhibits high thermal conductance,

similar to aluminum, and high electrical resistance and low loss typical of ceramics. Properly installed, it provides a low thermal resistance path allowing the anode heat to be transferred to the heat sink, while providing electrical isolation between the anode and the sink.

The 8874 requires forced-air cooling for its anode, which can often be accomplished most easily by means of a pressurized anode-compartment chassis, with air passing through the anode cooler and then exhausting. In such an installation, some air can be bled past the socket mount to provide base cooling if this is required.

The 8875 has a large transverse cooler on its anode, requiring forced-air cooling directed crossways. Maximum dissipation is realized with ducted air to the cooler, but operation at reduced dissipation levels is also possible with air supplied from a small general-purpose fan mounted in close proximity to direct air across the tube.

HEATER/CATHODE OPERATION - The rated heater voltage for the 8873, 8874, and 8875 is 6.3 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long life and consistent performance. At frequencies above approximately 300 MHz it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. The following heater operating voltages are recommended:

Frequency (MHz)	Heater Voltage
300 or lower	6.3
301 to 400	6.0
401 to 500	5.7

The potential between the heater and the cathode should be limited to plus or minus 150 Vdc.

CATHODE WARMUP TIME - Anode voltage may be applied simultaneously with heater voltage, but a minimum of 60 seconds warmup time should be allowed before drive voltage is applied to the grid to allow proper conditioning of the cathode surface.

ANODE CURRENT RATING AND TUNEUP PROCEDURE - The 8873, 8874, and 8875 are rated for 250 mAdc of continuous anode current. In intermittent voice (A3J emission) and interrupted carrier keying (A1 emission) service, which would be normal single-sideband-suppressed-carrier or keyed CW operation, and where short-term duty does not exceed 50%, the dc anode current (per tube) may be 500 mA during the "on" time. With 50% duty, the average current (per tube) would be 250 mA. During very short test periods, the tubes may be operated at the full 500 mA value but care must be taken to keep the "on" time as short as possible, with sufficient "off" time to allow for tube cooling.

Initial tuneup should preferably be done with reduced anode voltage and drive, and if done at the correct values, little or no retuning will be necessary when switching to full operating level. For the 2000 volt Intermittent Voice Service (IVS) condition, tuneup is recommended at 1500 volts and reduced grid drive. When anode voltage and drive are then raised, the full one kilowatt PEP IVS condition will be achieved with little or no retuning required.

COOLING-8873 - This tube is designed for use in a conduction-cooled system by using a beryllium oxide (BeO) thermal link between the anode and the heat sink. The heat sink in turn can be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. The design choice is determined by the tube application, but in all cases the cooling system must maintain the anode and the ceramic/metal seal temperatures below 250°C.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode through the BeO thermal link to the heat sink. A good thermally conductive compound should be used in the interface (between anode and BeO, and between BeO and heat sink) to reduce the thermal resistance of the joint. Examples of commercially available thermal joint compound are:

WAKEFIELD 120 - Wakefield Engineering Co., Wakefield, Mass. 01880

DOW CORNING 340 - Dow Corning Corp., Midland, Michigan 48640
ASTRODYNE THERMAL BOND 312 - Astrodyne Inc., Burlington, Mass. 01803
G.E. INSULGREASE G641 - G.E. Company, Cleveland, Ohio 44117

The method of fastening the tube to the heat sink should provide reasonable compression to reduce interface thermal resistance. A device such as the DE-STA-CO toggle clamp, modified by replacing the rubber nose with a ½-inch ceramic insulator, can provide a simple means of holding the tube securely and providing adequate compression.

The EIMAC SK-1920 BeO thermal link is recommended for use between the tube anode and the heat sink, as it is the correct size and thickness to match the physical and electrical characteristics of the 8873 tube.

A heat sink capable of handling 200 watts of continuous dissipation from the 8873 can be made with a section of finned aluminum alloy extrusion, such as Wakefield A-2494, or equivalent, cut to approximately 8 inches by 4 inches, backed with a 1/8-inch copper plate the same size. Thermal joint compound is used between the copper plate and the flat aluminum surface, with the two secured together at enough points to assure good continuous contact. The backed extrusion is mounted so as to allow for free air convection around the fins. The tube is then mounted, with the EIMAC SK-1920 thermal link, in the approximate center of the copper surface, with thermal joint compound again used between the tube anode and the BeO link, and between the BeO link and the copper. A device such as the modified DE-STA-CO toggle clamp is used to hold the tube securely in place.

Socketing is accomplished with one of the units mentioned earlier, mounted so as to allow for free air convection around the base of the tube and the socket, and on a bracket which returns to the same heat sink if possible. The designer is cautioned to allow for some lateral movement in the socket mount, and to make sure the anode is flat against the BeO thermal link so that good conduction contact exists before the socket mounts are tightened down. If the tube anode, the thermal link, and the heat sink are not making good flat contact, heat transfer will be seriously affected.

If unusually high ambient temperatures are expected, or more than 200 watts capability is required, a small fan can be used to move air past the sink cooling fins. With any conduction-cooled power tube, dissipation capability is almost completely dependent on the ability of the heat-sink system to carry heat away and the temperature limitations of the tube itself. Thus the 200-watt dissipation rating of the 8873 is a nominal value only, as illustrated by the fact that the same tube, with an axial-flow air radiator installed (the 8874) is rated for 400 watts of dissipation under specified cooling conditions.

In all cases, temperature of the tube anode and the ceramic/metal seals is the limiting factor, and the equipment designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

8874 - Forced-air cooling must be provided to maintain the anode core and seal temperatures within maximum rating. The cooling data shown is for sea level, with cooling air at 50°C, and is sufficient to limit tube temperatures to 225°C. The pressure drop figures shown are for the anode cooler only, as would be the case with a pressurized anode compartment of an equipment, where air would be required to pass through the anode cooler and then through an insulated duct to the outside of the cabinet. Some air from the pressurized anode compartment can be bled by the socket for base cooling, either by means of a somewhat oversize socket-mounting hole, or a series of small holes drilled in the chassis near the edges of the socket, in order to provide a small amount of air circulation around the base pins of the tube.

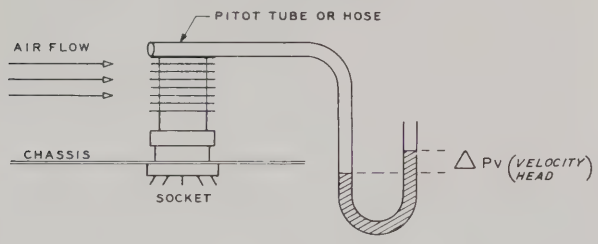
8874

Anode Diss.	Air Flow (CFM)	Approx. Press. Drop ($In.H_2O$)
200 W	4.0	0.11
300 W	6.0	0.22
400 W	8.6	0.37

8875 - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. Cooling data is shown for sea level, with cooling air at 25°C.

These figures are for the case where the cooling air is supplied from a small general-purpose fan in close proximity to the tube and directing air across the tube and through the anode cooler.

The recommended cooling is sufficient to limit tube temperatures to 225°C. The required air velocity can be checked with a simple manometer, as shown in the accompanying figure.



8875

Anode Diss.	Cooling Air Velocity	Vel.Head(ΔPv) Inches of H_2O
200W	870 Ft/Min.	0.045
300W	1600 Ft/Min.	0.16

With all three tube types, the equipment designer is cautioned that it is not good practice to operate at, or very close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined here is normally beneficial.

DANGER-BERYLLIUM OXIDE CERAMICS (BeO) Do not alter, grind, lap, fire, chemically clean,or perform any other operation on the SK-1920 Beryllium Oxide thermal link used with the 8873, or any other equivalent section of BeO used with the 8873. Normal use of Beryllium Oxide ceramics parts is not hazardous, but the user is cautioned that breathing small quantities of the dust or fumes from Beryllium Oxide can seriously injure or kill.

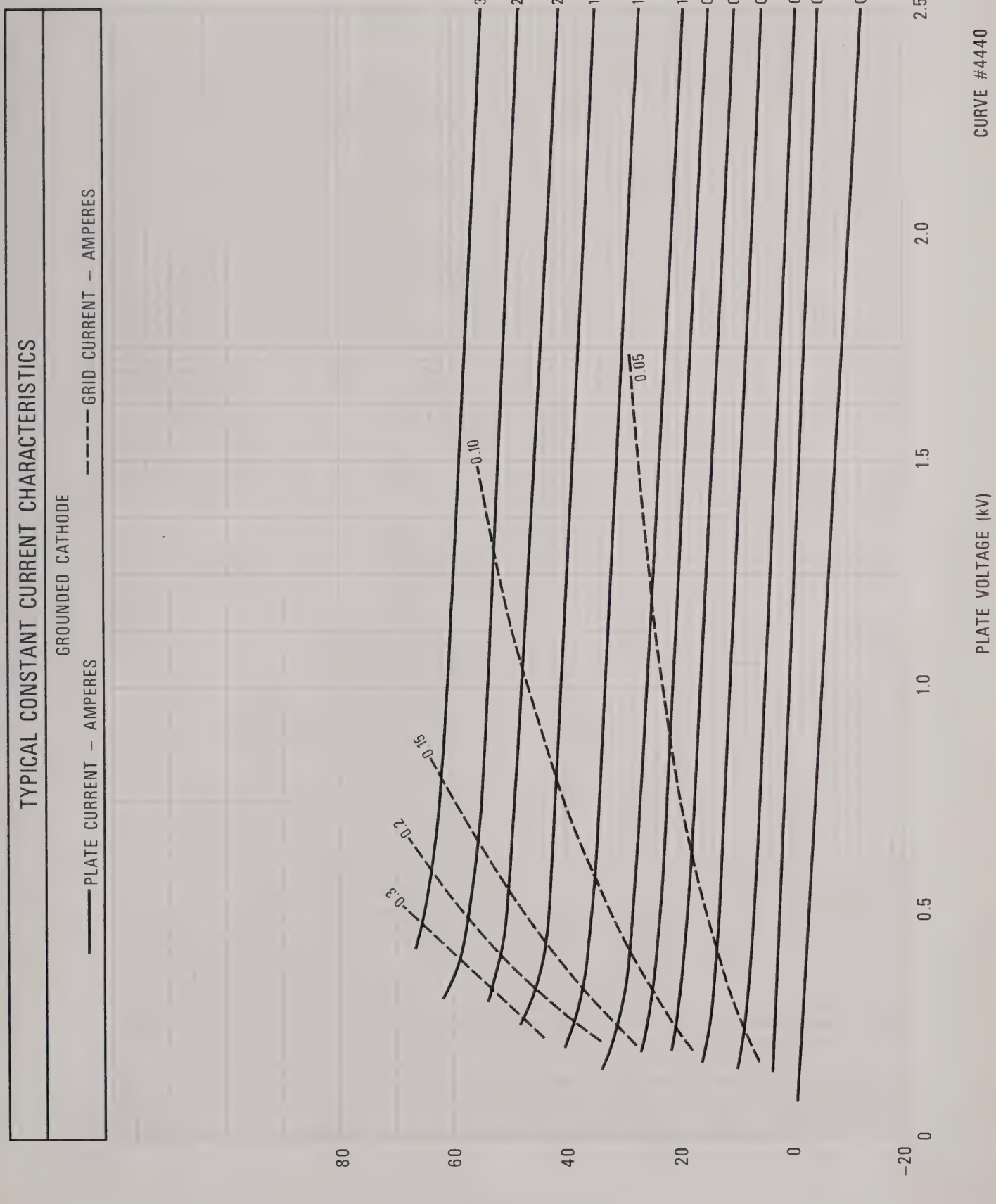
HIGH VOLTAGE - The 8873, 8874, and 8875 operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

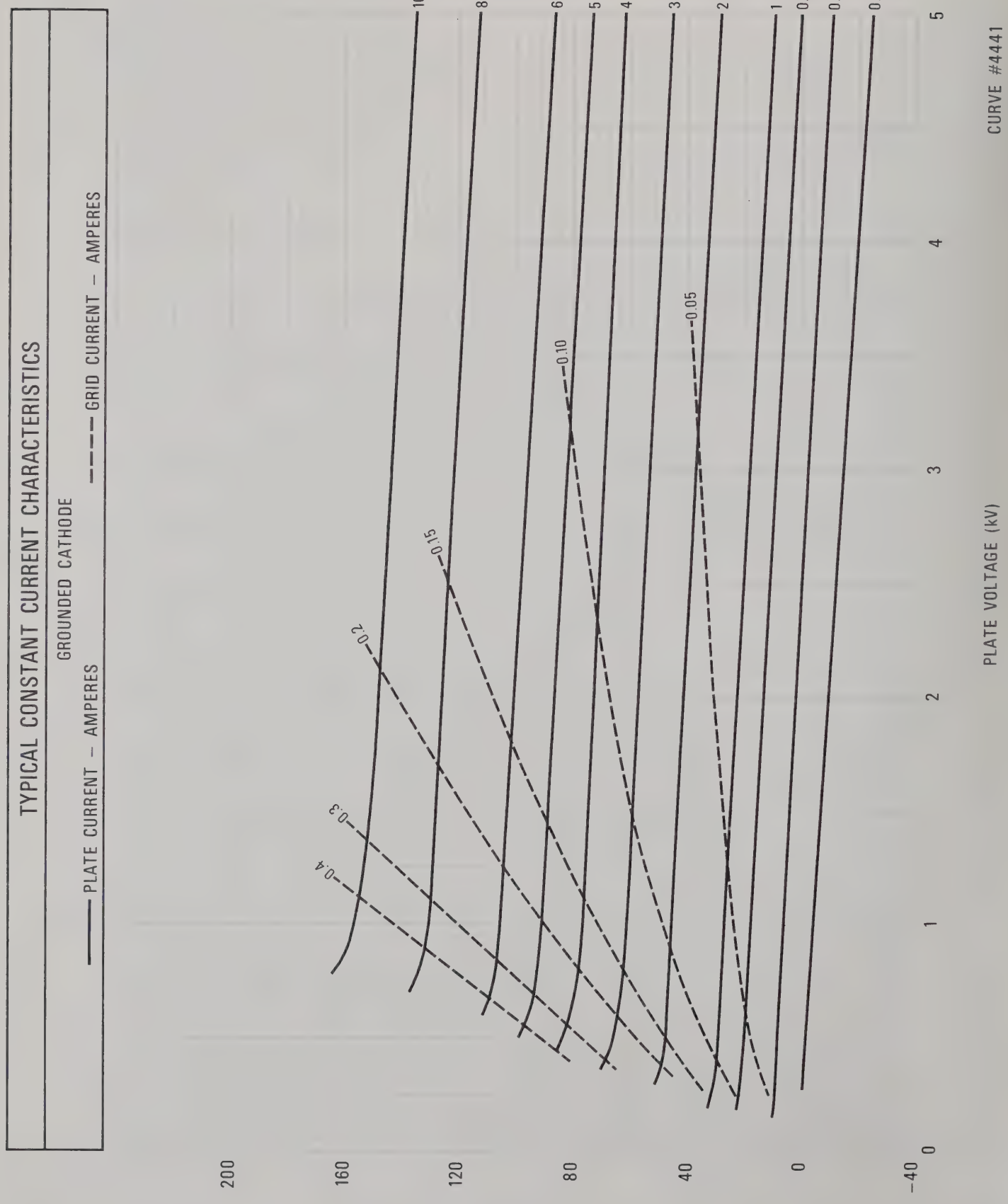
OUTPUT CAPACITANCE - The interelectrode capacitance figures given in the General Characteristics are measured in a shielded fixture and do not include additional external capacitance. Including the stray capacitance between the anode and the heat sink used with the 8873 tube will typically raise the output capacitance to somewhat more than double the measured internal value.

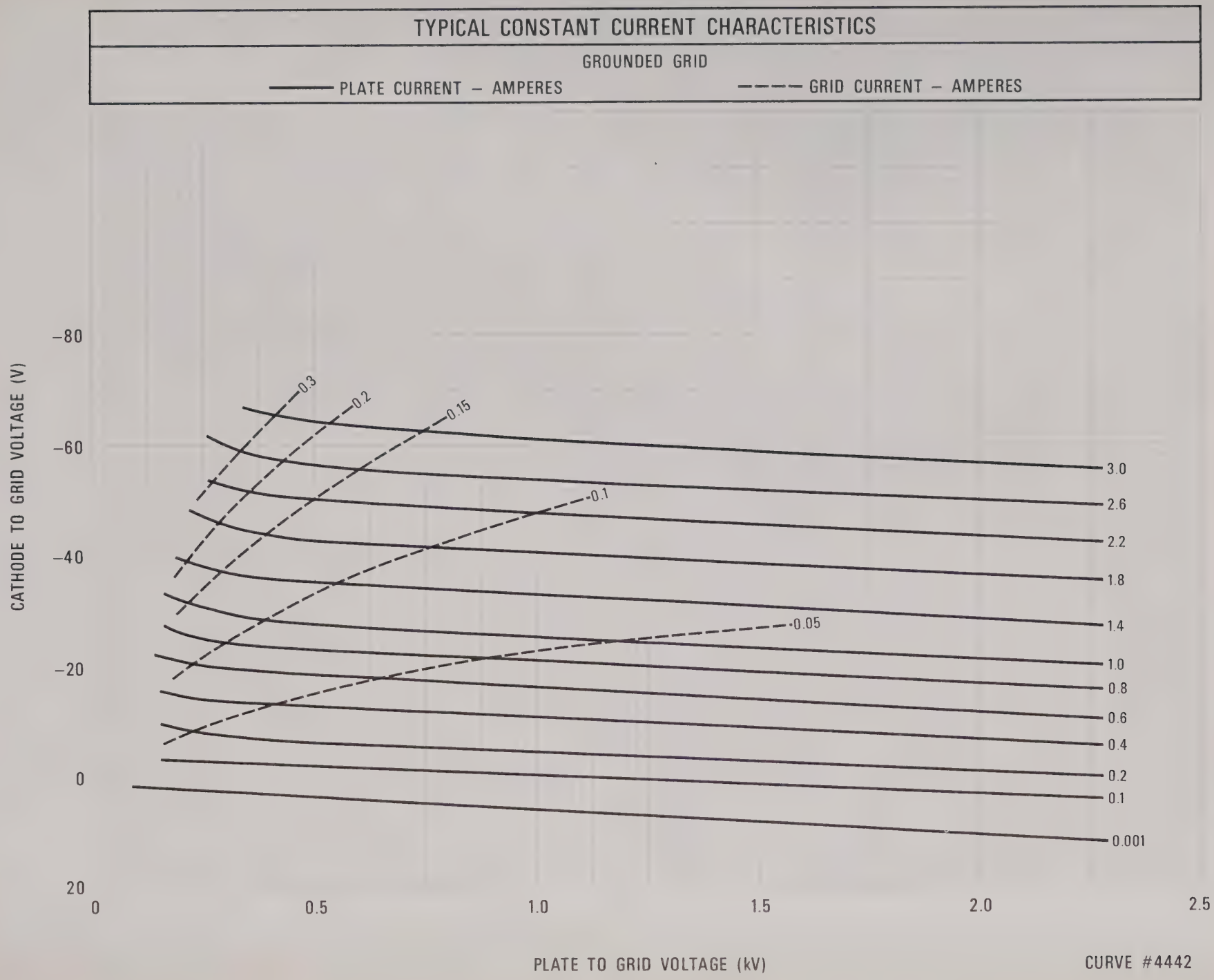
INTERMODULATION DISTORTION - Typical Operating Conditions, with distortion values included, are the result of data taken during actual operation at 2 Megahertz. Intermodulation values listed are those measured at the full peak envelope power noted and are referenced against one tone of a two-equal tone signal.

INPUT CIRCUIT - When any of these types is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

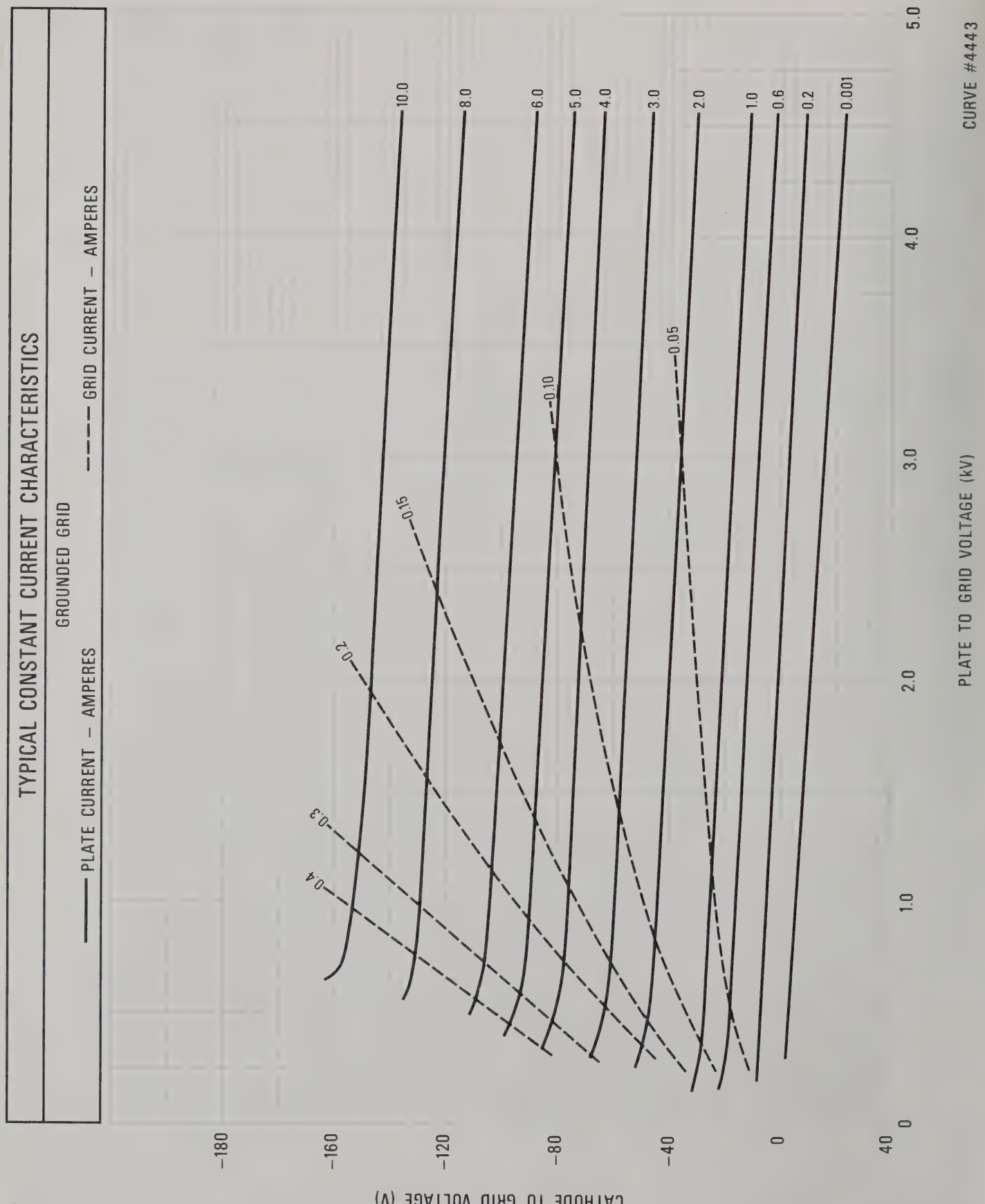
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
3.0
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0.001
0.10
0.05
0.15
0.3
2.0
80
60
40
20
0
−20
0
0.5
1.0
1.5
2.0
2.5
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4440

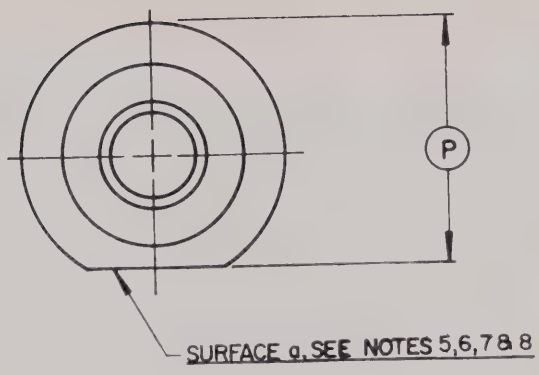

TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
200
160
120
80
40
0
-40
0
1
2
3
4
5
PLATE VOLTAGE (kV)
10
8
6
5
4
3
2
1
0.6
0.2
0.001
2.0
0.3
0.4
0.15
0.10
0.05
CURVE #4441



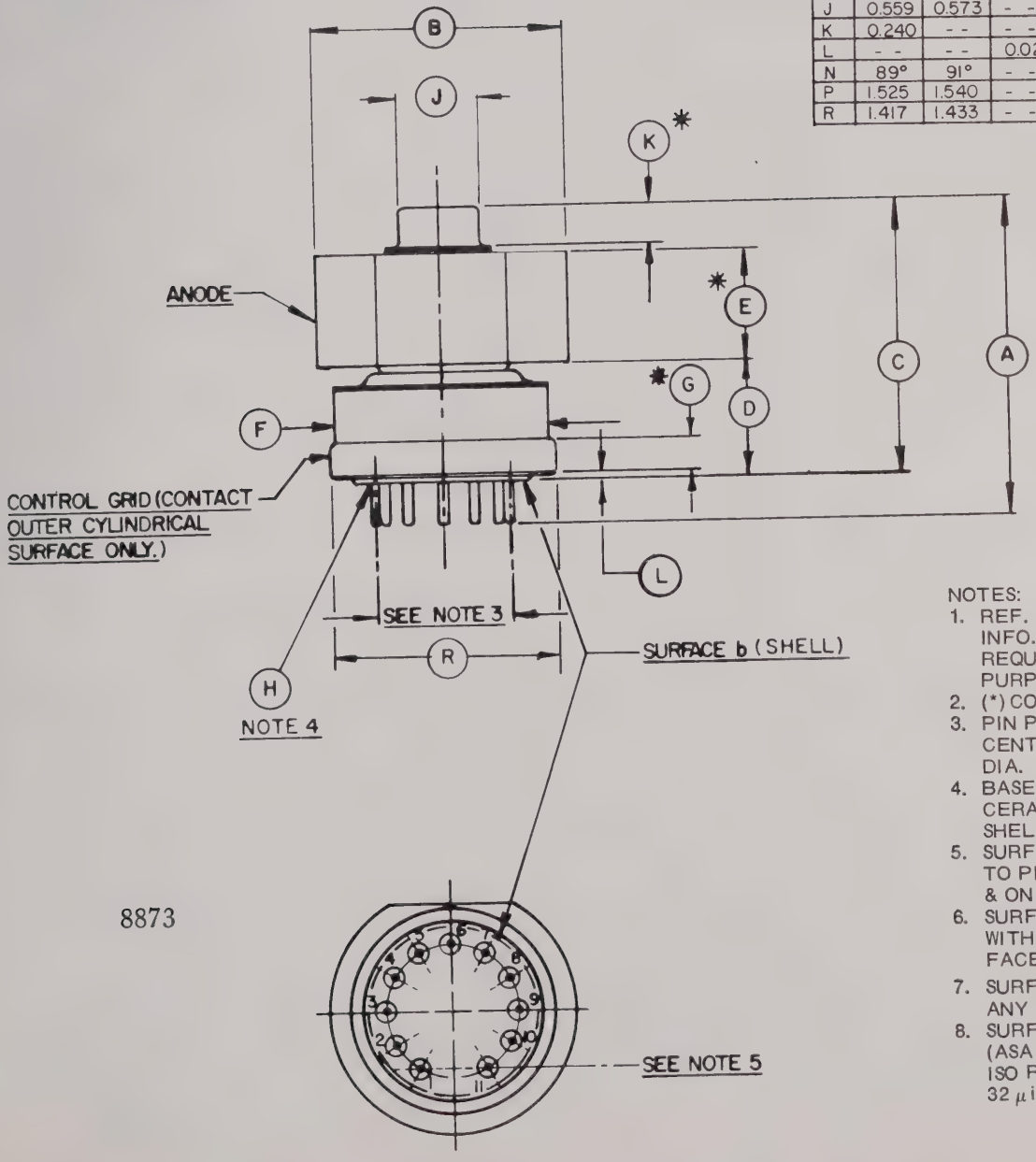
8873, 8874, 8875


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
0.15
0.10
0.05
0.2
0.3
0.4
CATHODE TO GRID VOLTAGE (V)
-180
-160
-120
-80
-40
0
40
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
CURVE #4443

PIN NO. 1 CATHODE
PIN NO. 2 CATHODE
PIN NO. 3 CATHODE
PIN NO. 4 CONTROL GRID
PIN NO. 5 HEATER
PIN NO. 6 HEATER
PIN NO. 7 CONTROL GRID
PIN NO. 8 CATHODE
PIN NO. 9 CATHODE
PIN NO. 10 CATHODE
PIN NO. 11 CONTROL GRID



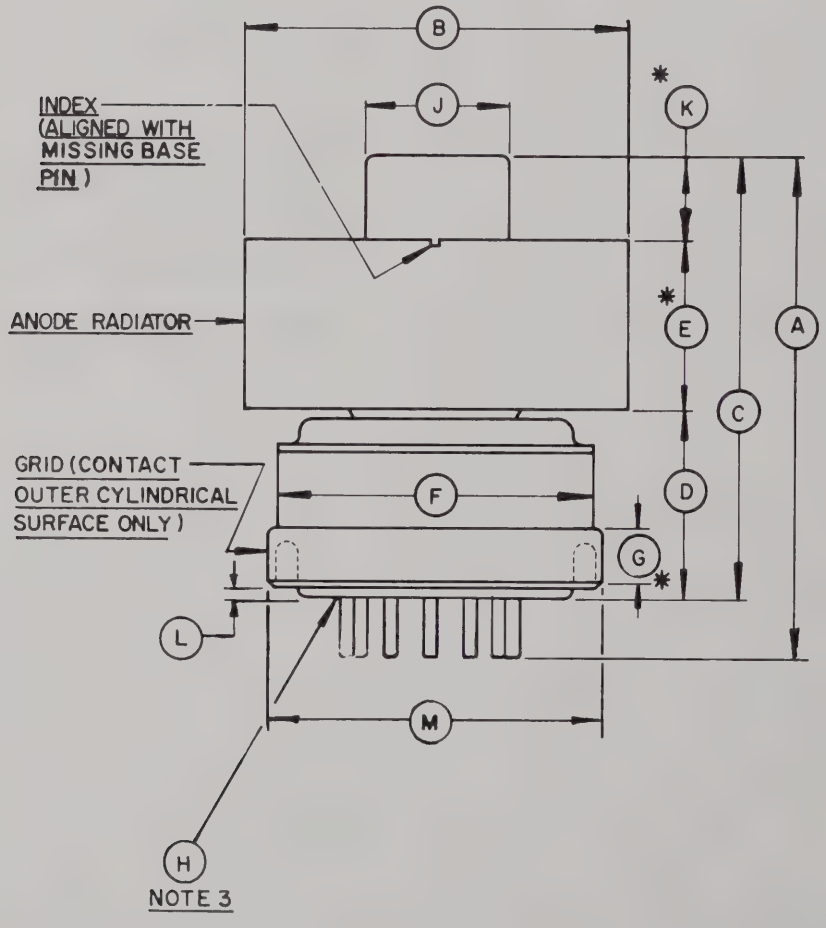
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
N	89°	91°	- -	89°	91°	- -
P	1.525	1.540	- -	38.73	39.12	- -
R	1.417	1.433	- -	35.99	36.40	- -



NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.
5. SURFACE a TO BE PARALLEL TO PINS I & II AXIS WITHIN 2° & ON OPPOSITE SIDE.
6. SURFACE a MUST BE FLAT WITHIN .001 & PERP. TO SURFACE b WITHIN N LIMITS.
7. SURFACE a TO BE FREE OF ANY CODING OR LABELING.
8. SURFACE a ROUGHNESS (ASA B46.1-1962 OR ISO R468-66) — 32 μin. 6.8 μm.

PIN No.1: CATHODE
PIN No.2: CATHODE
PIN No.3: CATHODE
PIN No.4: GRID
PIN No.5: HEATER
PIN No.6: HEATER
PIN No.7: GRID
PIN No.8: CATHODE
PIN No.9: CATHODE
PIN No.10: CATHODE
PIN No.11: GRID

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
M	1.417	1.433	- -	35.99	36.40	- -

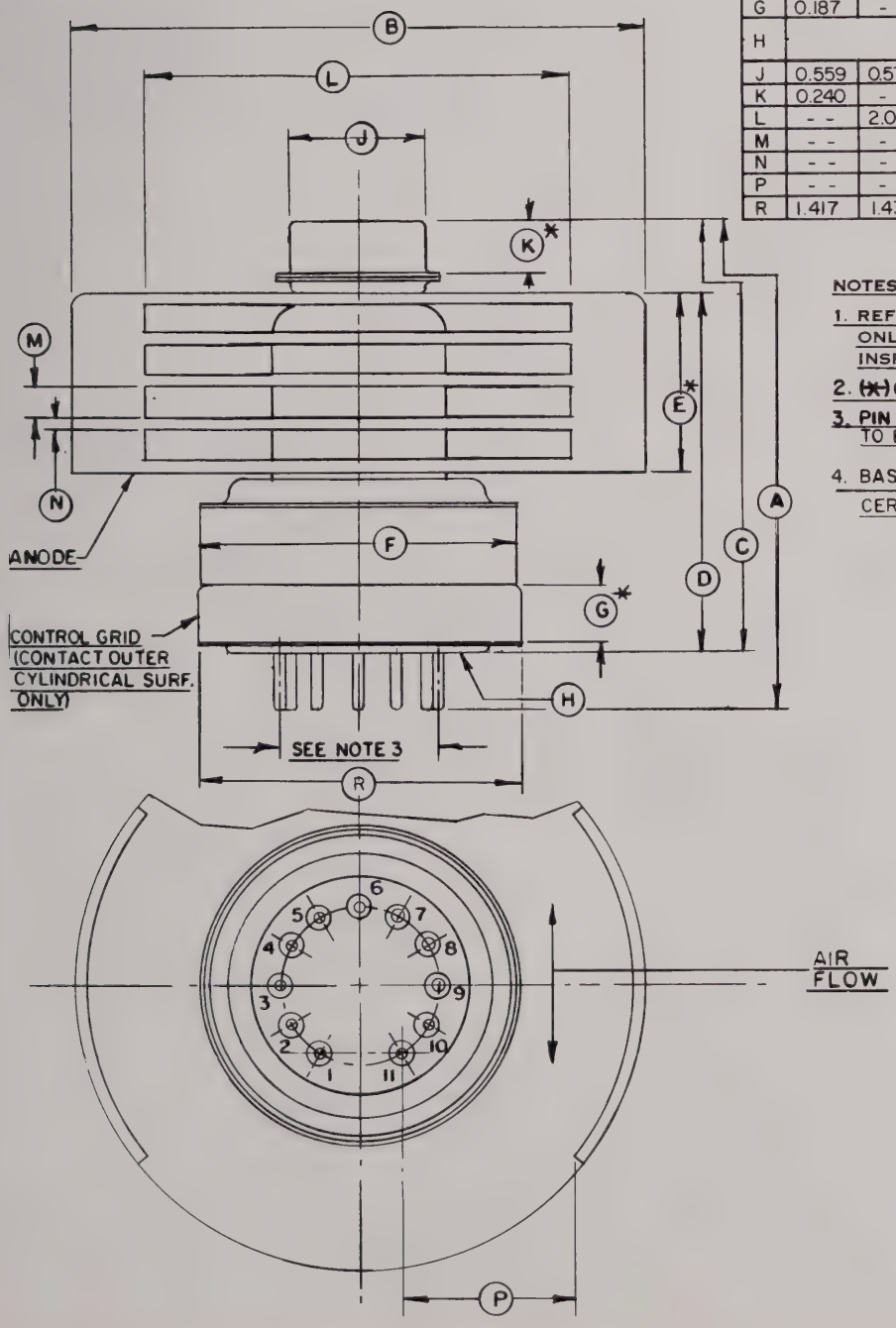


NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.
3. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL

8874

PIN No.1,2,3,8,9,10	CATHODE
PIN No.4,7,11	CONTROL GRID
PIN No.5,6	HEATER

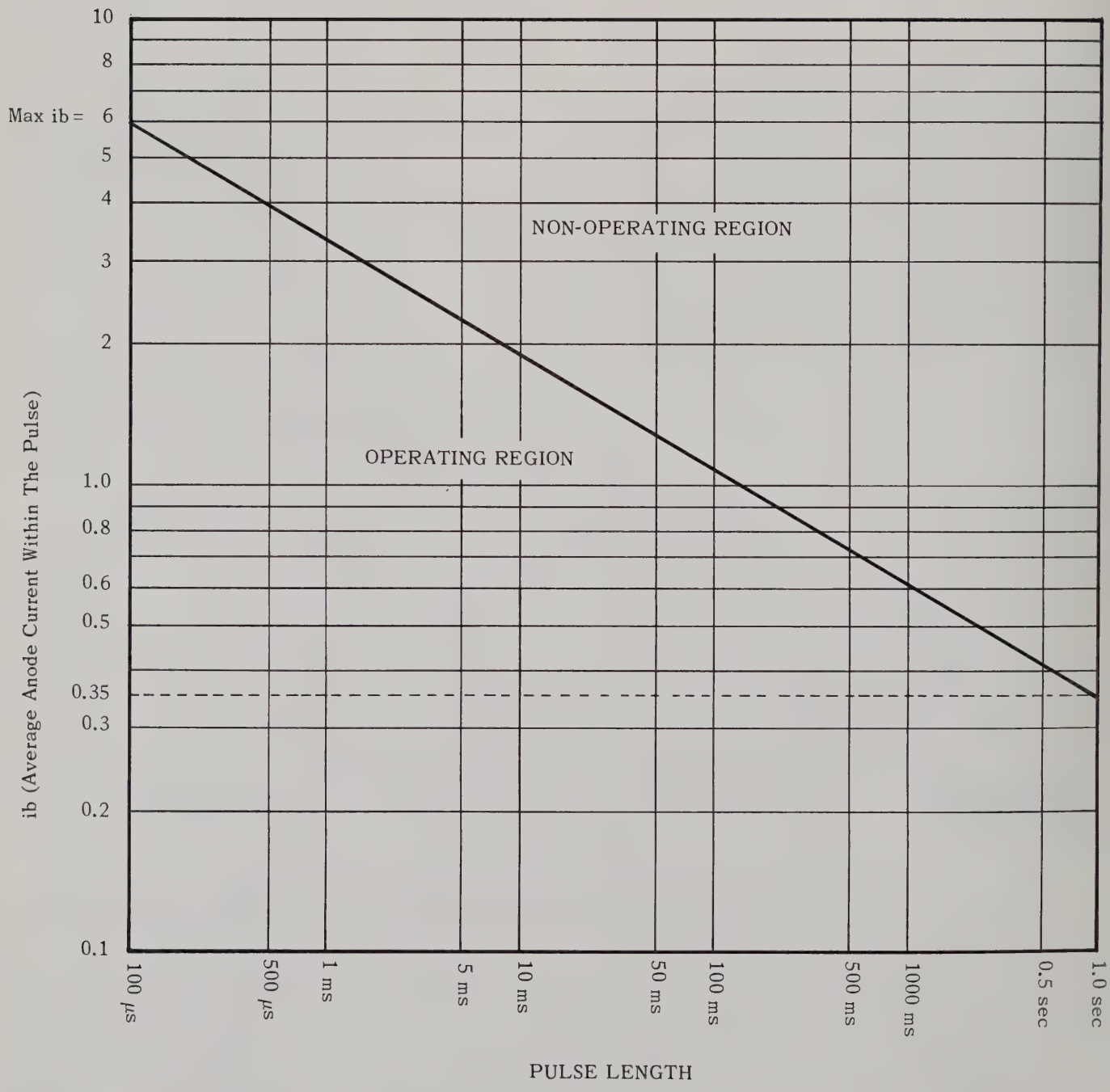
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	2.185	- -	- -	55.50	- -
B	2.480	2.520	- -	62.99	64.01	- -
C	1.867	1.997	- -	47.42	50.72	- -
D	1.514	1.644	- -	38.46	41.76	- -
E	0.750	0.830	- -	19.05	21.08	- -
F	- -	- -	1.406	- -	- -	35.71
G	0.187	- -	- -	4.75	- -	- -
H	BASE E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	2.000	- -	- -	50.80	- -
M	- -	- -	0.135	- -	- -	3.43
N	- -	- -	0.050	- -	- -	1.27
P	- -	- -	0.560	- -	- -	14.22
R	1.417	1.433	- -	35.99	36.40	- -



NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. ~~(K)~~ CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.

8875



Pulse anode current (ib) capability is dependent on pulse length (tp) and duty factor (Du). Maximum ib for a given tp is shown; maximum Du may then be derived from the relationship: $0.350 = ib \sqrt{Du}$

PULSE DERATING CHART, TYPES 8873, 8874, 8875

PULSE MODULATOR OR REGULATOR SERVICE

8938

UHF
HIGH-MU
POWER TRIODE

TECHNICAL DATA

The EIMAC 8938 is a rugged coaxial-base ceramic/metal power triode designed for use as a cathode driven Class AB_2 or Class C amplifier.

It is recommended for VHF or UHF service as a linear amplifier, power amplifier, or pulse amplifier. Linearity and power gain are both excellent due to the low ratio of grid to plate current, and the relatively high amplification factor. Low grid interception of available emission current is due to the beam forming geometry of the special grid and cathode design.

The 8938 is a practical size for use in ground based or mobile equipment in CW or PEP power levels of 1 to 2.5 kW. It is useful at frequencies higher than the upper frequency of maximum ratings, 500 MHz.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide-Coated, Unipotential		
Heater: Voltage	5.0 ± 0.25	V
Current, @ 5.0 volts	10.5	A
Transconductance (average)		
I_b = 1.0 Adc	55,000	μmhos
Amplification Factor (average)	125	
Direct Interelectrode Capacitances (grounded grid) [2]		
Cin	39	pF
Cout	13	pF
Cpk	0.14	pF
C k-htr	12.8	pF
Frequency of Maximum Rating	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:		
Length	3.57 in; 91.00	mm
Diameter	3.38 in; 85.85	mm
Net Weight	25 oz; 709	gm
Operating Position	Any	

(Revised 5-15-73) ©1972 by Varian Printed in U.S.A.

EIMAC division of varian / 301 industrial way / san carlos / california 94070

Maximum Operating Temperature:	
Ceramic/Metal Seals, Anode Core	250°C
Cooling	Forced Air
Base	Coaxial
Socket (grounded grid)	SK-2220

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN Class AB_2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_2 Cathode Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	3500	Vdc
Grid Voltage [1]	-20	Vdc
Zero-Signal Plate Current	300	mAdc
Single-Tone Plate Current	970	mAdc
Two-Tone Plate Current	715	mAdc
Single-Tone Grid Current [3]	39	mAdc
Two-Tone Grid Current [3]	12	mAdc
Peak rf Cathode Voltage [3]	71	v
Driving Power [3]	50	W
Useful Output Power [4]	2030	W
Resonant Load Impedance	2200	Ohms
Intermodulation Distortion [2]		
3rd Order Products	-44	dB
5th Order Products	-44	dB

1. Positive cathode bias provided by zener diode.
2. The intermodulation distortion products are referenced against one tone of a two equal-tone signal.
3. Approximate value.
4. Delivered to the load.

RADIO FREQUENCY POWER AMPLIFIER
Class B or C

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Cathode Driven Amplifier)

Frequency of Operation	400	MHz
Heater Voltage	4.3	V
DC Plate Voltage	3000	V
DC Grid Voltage	-31	V
DC Plate Current	1.0	A
DC Grid Current	5	mA
Measured Driving Power	83	W
Useful Output Power	1570	W
Power Gain	12.8	dB

APPLICATION

MECHANICAL

MOUNTING - The 8938 may be mounted in any position.

SOCKET - The EIMAC SK-2220 socket is designed for use with the 8938 tube, making contact to the two heater terminals, the cathode, and the grid terminal. The grid is grounded to the frame of the socket.

Individual contact collets are also available from EIMAC to fit the 8938 as follows:

TUBE ELEMENT	EIMAC PART NO.
Anode	135304
Grid	135305
Cathode	135306
Heater	135307
Heater (center pin)	135310

These collets are described by EIMAC drawing SK-2221-60.

COOLING - The maximum temperature limit for all external tube surfaces and the anode core is 250°C. Tube life is prolonged, however, if these areas are maintained at a lower temperature. The cooling data shown is for the anode cooler only and the flow rates indicated will hold tube temperature below 225°C with 50°C ambient temperature at sea level at low frequencies. At frequencies above 30 MHz, or at higher altitudes, the air quantity must be increased. A small amount of additional cooling air is required around the base of the tube to maintain seal and envelope temperatures in this area within ratings.

Anode Dissipation Watts	SEA LEVEL		10,000 FEET	
	Air Flow CFM	Pressure Drop Inches	Air Flow CFM	Pressure Drop Inches
500	12.8	.08	18.7	.11
1000	27.6	.24	40.0	.35
1500	50.0	.70	73.0	1.01

Note: An allowance has been made for 25 watts of grid dissipation and 50 watts of heater power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8938 is 5.0 V. For CW operation at the higher end of the frequency range of the 8938, it is advisable to reduce the heater voltage by a small percentage. For a CW or average power output of 1 kW or more at 400 MHz, it is recommended that heater voltage be reduced to 4.3 V. At frequencies between 400 and 200 MHz, nominal heater voltage, for the power level above, should be obtained from a straight line curve defined by 4.3 V at 400 MHz and 5.0 V at 200 MHz.

In equipment intended for a broad range of frequencies a fixed compromise heater voltage is suggested. This may be the lowest heater voltage which provides adequate cathode emission current at the lower end of the frequency range, and should be between 4.3 and 5.0 volts.

GRID OR CATHODE BIAS - It is convenient in linear amplifier service to use a zener diode or series of zener diodes in the cathode circuit if bias is required. The power loss is small because linear amplifier bias will generally be less than 25 volts. Conventional grid bias sources may be used for CW or pulse applications.

UHF OPERATION - The 8938 provides very high gain at UHF with simple cavity designs, as a result of beam focusing action of a series of strip electron guns in the cathode-grid region, which produces very high mu with unusually low grid interception.

Use of a high-mu triode in the cathode-driven configuration at UHF simplifies circuitry in many ways.

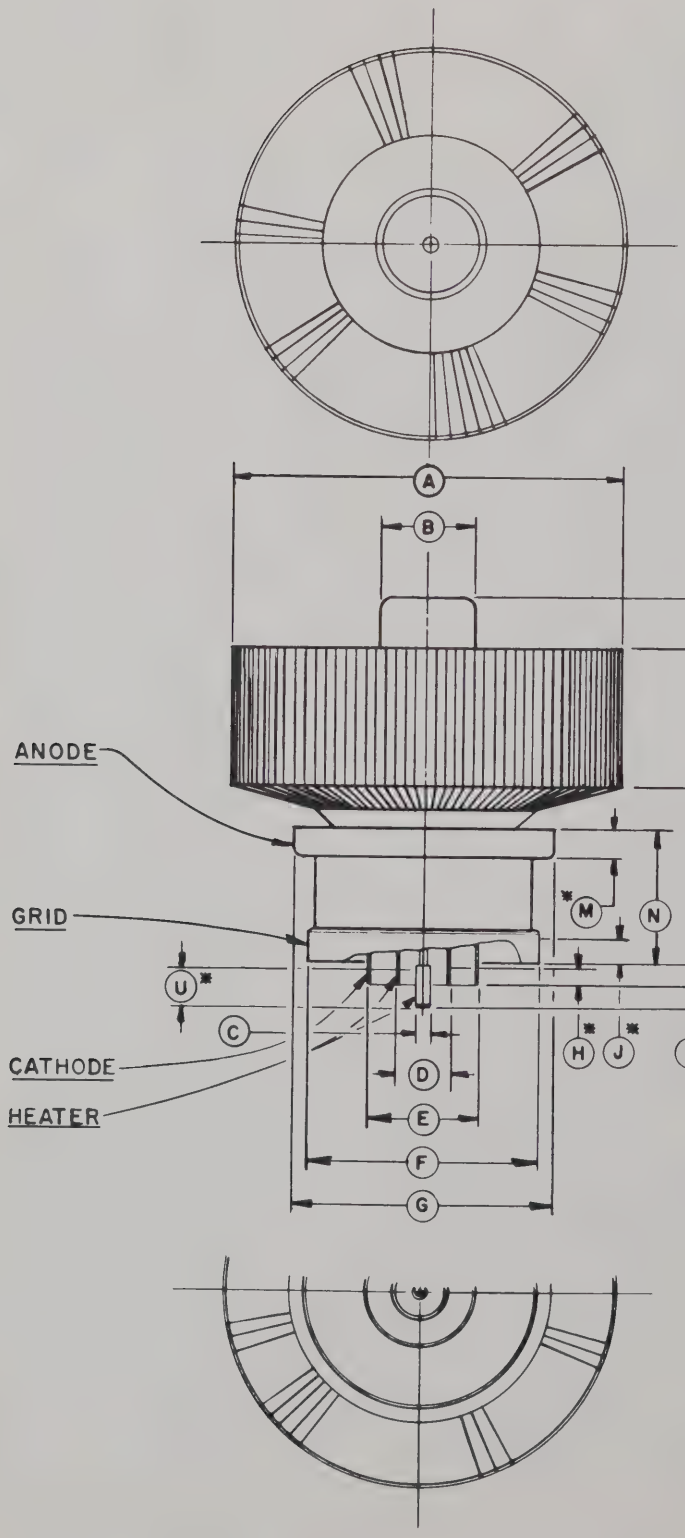
HIGH VOLTAGE - The 8938 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed, Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interkock swithces to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between the tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures with effectively shield all external tube terminals or leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the

socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

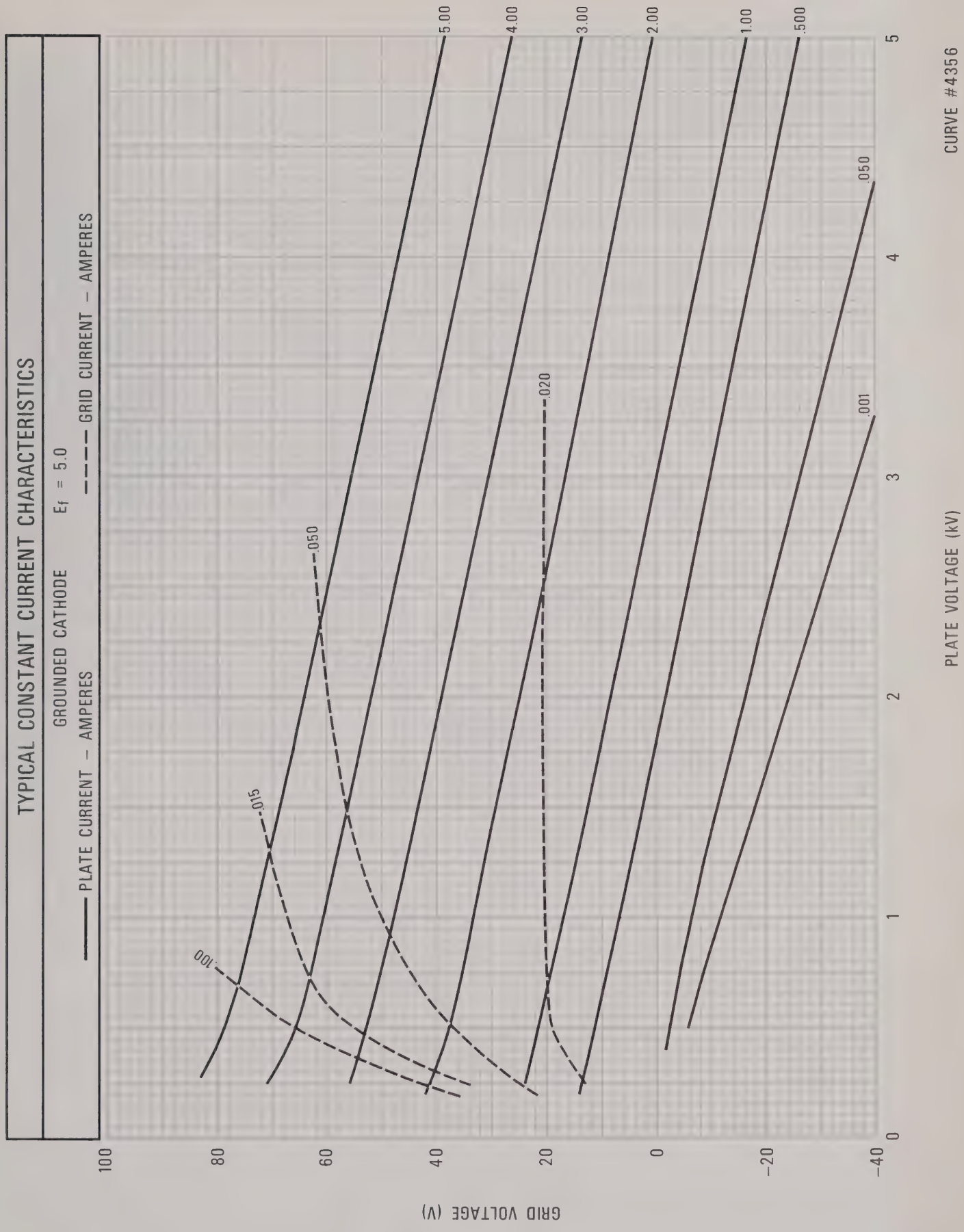
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



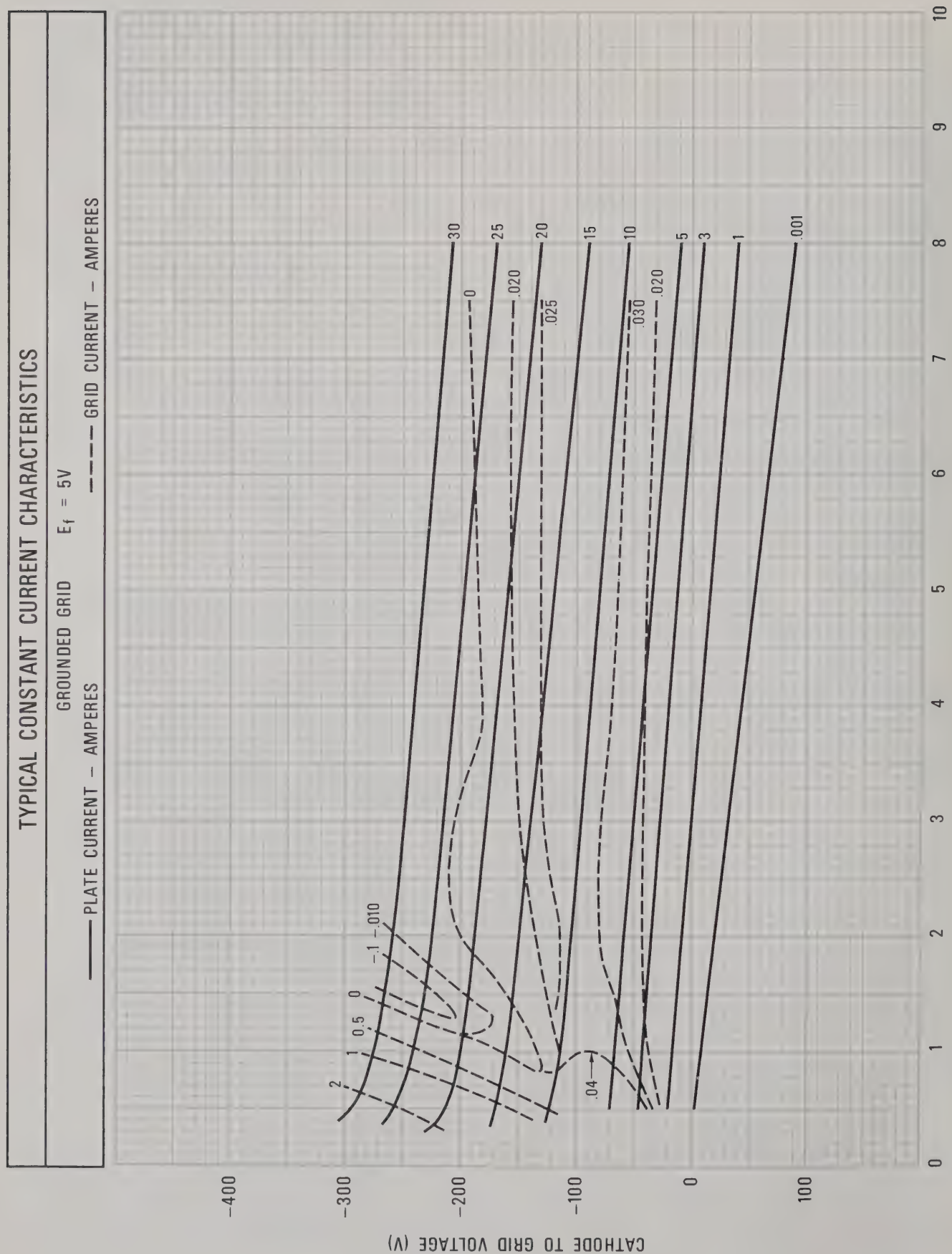
DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.350	3.380	- -	85.09	85.85	- -
B	.810	.820	- -	20.57	20.83	- -
C	.120	.127	- -	3.05	3.23	- -
D	.477	.487	- -	12.12	12.37	- -
E	.965	.975	- -	24.51	24.76	- -
F	1.995	2.015	- -	50.67	51.18	- -
G	2.245	2.255	- -	57.02	57.28	- -
H	.235	- -	- -	5.97	- -	- -
J	.235	- -	- -	5.97	- -	- -
K	.170	.200	- -	4.32	5.08	- -
L	.370	.400	- -	9.40	10.16	- -
M	.235	- -	- -	5.97	- -	- -
N	1.110	1.170	- -	28.19	29.72	- -
P	1.400	1.530	- -	35.56	38.86	- -
R	2.600	2.730	- -	66.04	69.34	- -
S	3.015	3.175	- -	76.58	80.64	- -
T	.380	.480	- -	9.65	12.19	- -
U	.350	- -	- -	8.89	- -	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE.
3. DIMENSIONS C, D, E TO BE CONCENTRIC WITH F & G WITHIN .015 DIA.
4. DIMENSIONS A & B TO BE CONCENTRIC WITH F & G WITHIN .040 DIA.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
Ef = 5.0
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
5.00
4.00
3.00
2.00
1.00
.500
.050
.020
.001
.050
.015
.100
100
80
60
40
20
0
–20
–40
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)

CURVE #4356


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID E_f = 5V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (kV)
CURVE #4435
-400
-300
-200
-100
0
100
0
1
2
3
4
5
6
7
8
9
10
30
25
20
15
10
5
3
1
.001
0
.020
.025
.030
.020
2
1
0.5
0
-.1
-.010
.04

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

5-1-74

(Effective 5-1-74) © 1974 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 5-1-74
Index 5-1-74
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 5-1-74
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 5-1-74
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 11-15-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 5-1-68
3-500Z 11-1-73
3-1000Z/8164 3-15-67
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 1-11-74
3CW5000F3/8243 . . . . . see 3CW5000A3
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 3-1-67
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX1000A7/8283 11-1-68
3CX1500A7/8877 8-1-73
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7480 11-1-68
8873/8874/8875 6-3-73
8874 . . . . . see 8873
8875 . . . . . see 8873
8938 5-15-73

TETRODES

4-65A/8165 5-1-62
4-125A/4D21 6-1-67
4-250A/5D22 5-5-70
4-400A/8438 7-20-70
4-400C/6775 4-1-71
4-500A 3-10-72
4-1000A/8166 10-30-66
4CN15A 6-1-68
4CPX250K/8590 4-1-70
4CS250R 9-1-70
4CV8000A 3-15-71
4CV20,000A 6-1-68
4CV35,000A 5-15-66
4CV50,000E 5-1-70
4CV50,000J 7-15-71
4CV75,000A 6-15-71
4CV100,000C/8351 2-1-68
4CV250,000A 3-1-72
4CW800B/F 11-1-73
4CW2000A/8244 6-15-71
4CW10,000A/8661 4-15-63
4CW25,000A 2-1-72
4CW50,000E 7-1-70
4CW50,000J 7-15-71
4CW100,000D 7-1-67
4CW100,000E 9-1-70
4CW250,000A 3-1-71
4CX125C/F 6-1-67
4CX250B/7203 & 4CX250F/7204 5-15-73
4CX250K/8245 & 4CX250M/8246 5-1-68
4CX250R/7580W 6-16-61
4CX300A/8167 8-30-66
4CX300Y/8561 6-15-66
4CX350A/8321 & 4CX350F/8322 6-15-65
4CX350FJ/8904 9-1-71
4CX600B & 4CX600F 3-20-70
4CX600J/8809 & 4CX600JA/8921 8-15-71
4CX1000A/8168 5-1-70
4CX1000K/8352 8-20-66
4CX1500A 12-1-71
4CX1500B/8660 6-1-67
4CX3000A/8169 5-1-67
4CX5000A/8170 4-15-69
4CX5000J/8909 10-1-71
4CX5000R/8170W 4-15-71
4CX10,000D/8171 1-1-72
4CX10,000J 2-1-72
4CX15,000A/8281 12-15-73
4CX15,000J/8910 10-15-71
4CX35,000C/8349 12-1-70
4W300B/8249 11-1-73
4W20,000A/8173 4-15-64
4X150A/7034 & 4X150D/7035 5-4-70
4X150G/8172 10-15-73
4X500A 1-1-64
6816,6884,7843 11-15-71
6884 . . . . . see 6816
7843 . . . . . see 6816
8560A 7-15-71
8876 6-15-71
8930 12-1-73
X2159 7-1-73

PENTODES

5-125B/4E27A 8-15-52
5-500A 5-1-68
5CX1500A 6-6-70
5CX3000A 8-1-67
264/8576 6-5-70
290 5-5-70
8295A 1-15-73

PULSE MODULATORS

4PR60C/8252W 6-30-71
4PR65A/8187 2-15-63
4PR125A/8247 3-15-64
4PR250C/8248 9-1-70
4PR400A/8188 9-15-65
4PR1000A/8189 12-15-65
6C21 12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6 4-4-70
Preformed Contact Finger Stock 6-15-71
HR Heat Dissipating Connectors 12-1-65
SK-300A 4-15-69
SK-306, SK-316 8-15-66
SK-400 4-1-56
SK-406, SK-416, SK-426 12-1-73
SK-410 12-1-73
SK-500 3-15-67
SK-506, SK-516 4-15-69
SK-510 6-15-71
SK-600A, SK-610A 6-15-71
SK-606, SK-626, SK-636B 8-15-66
SK-607 8-15-71

(Cont'd)

OTHER PRODUCTS

SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A, SK-712A	3-15-71
SK-740	8-15-66
SK-760, SK-770	7-27-70
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-860, SK-870	3-15-67
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210	8-15-72



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

5-1-74

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-240A	R
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000F3/8243	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW25,000A3	T
3CW30,000H3	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV75,000A	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203	TET
4CX250F/7204	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4W20,000A/8173	TET
4X150A/7034	TET
4X150D/7035	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
X-2150	TET
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

TECHNICAL DATA

4CW800B
4CW800F

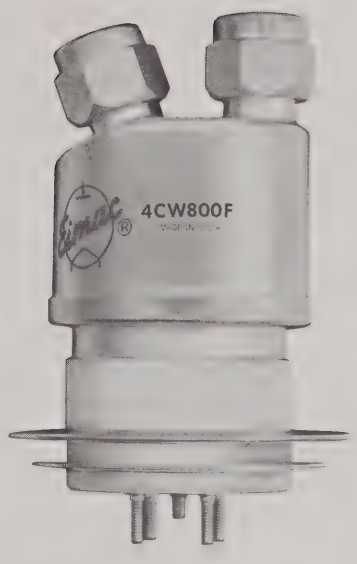
RADIAL BEAM
POWER TETRODE

The EIMAC 4CW800B and 4CW800F are ceramic/metal, liquid cooled radial-beam tetrodes designed for use in distributed amplifiers and VHF/UHF power amplifiers.

The mechanical and electrical features of these tubes are compatible with distributed amplifier circuit requirements, i.e., low lead inductance, low input and output capacitance and small size.

Ruggedized construction consisting of a unitized electrode structure and direct mounting to the chassis, combine to make the 4CW800B and 4CW800F suitable for environments of severe shock and vibration.

The maximum rated plate dissipation is 800 watts for both types.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: 4CW800B

Voltage	6.0	V
Current	4.4	A

Heater: 4CW800F

Voltage	26.5	V
Current	1.1	A
Transconductance: (I_b = 600 mAdc)	40,000	μmhos
Input Conductance: (I_b = 600 mAdc) (F = 30 MHz)	0.1×10^{-3}	mhos
Frequency for Maximum Ratings	800	MHz

Direct Interelectrode Capacitance: (Grounded Cathode) [2]

Cin	45	pF
Cout	5.8	pF
Cgp	0.15	pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Base	Special
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Base Plate	150°C
Cooling	Liquid

(Revised 11-1-73) © 1968, 1973 by Varian Printed in U.S.A.

Maximum Over-all Dimensions:

Length	3.00 In; 76.20	mm
Diameter	2.03 In; 51.56	mm
Net Weight	7 oz; 198	gm

RANGE VALUES FOR EQUIPMENT DESIGN

Heater: 4CW800B - Current at 6.0 volts	4.0	4.7	A
4CW800F - Current at 26.5 volts	0.85	1.25	A
Cathode Warmup Time - both types	180	---	sec.
Interelectrode Capacitances (grounded cathode circuit)[1]			
Cin	42.0	48.0	pF
Cout	5.3	6.3	pF
Cgp	---	0.20	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

BROADBAND RF LINEAR AMPLIFIER

Class AB, Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	800	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	3	WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION

Plate Voltage	1000	1500	2500	Vdc
Screen Voltage	275	275	275	Vdc
Grid Voltage[1]	-40	-40	-40	Vdc
Zero Signal Plate Current	100	100	100	mAdc
Plate Current	570	580	585	mAdc
Screen Current[2]	32	29	17	mAdc
Peak rf Grid Voltage[2]	44	43	42	v
Plate Output Power[2]	320	590	1000	W
Plate Dissipation[2]	250	280	460	W
rf Load Impedance	765	1225	2325	Ω

RADIO FREQUENCY POWER AMPLIFIER

Class B, Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	800	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	3	WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.
3. Delivered to the load.

TYPICAL OPERATION	140-250 MHz Strip-line amp			432 MHz Cavity	865 MHz Cavity	
Plate Voltage	1650	1950	2500	2000	2000	Vdc
Screen Voltage	400	300	300	300	300	Vdc
Grid Voltage[1]	-75	-60	-60	-54	-60	Vdc
Zero Signal Plate Current	15	15	15	20	15	mAdc
Maximum Signal Plate Current	600	530	600	600	600	mAdc
Screen Current[2]	14	11	11	7	8	mAdc
Grid Current[2]	-6	-2	+8	+14	0	mAdc
Useful Power Output[3]	540	555	820	770	550	W
Bandwith (3dB) of Amplifier	6	6	4.5	---	9	MHz
Power Gain[2]	---	---	---	15.3	10.4	dB

APPLICATION

MECHANICAL

MOUNTING - These tubes may be mounted in any position. No socket is required. The tube may be mounted directly on the SK-680 Screen Bypass Capacitor which in turn is mounted to the chassis with four 6-32 screws. The chassis thickness should be 0.062 inch to insure adequate space for connections to the base of the tube and care should be exercised to insure a flat mounting surface to minimize cathode lead inductance.

COOLING - Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-metal seals	250°C
Base and flanges	150°C

Anode cooling is accomplished by circulating liquid through the integral water jacket.

At ambient temperatures of 25°C or less, no base cooling is required.

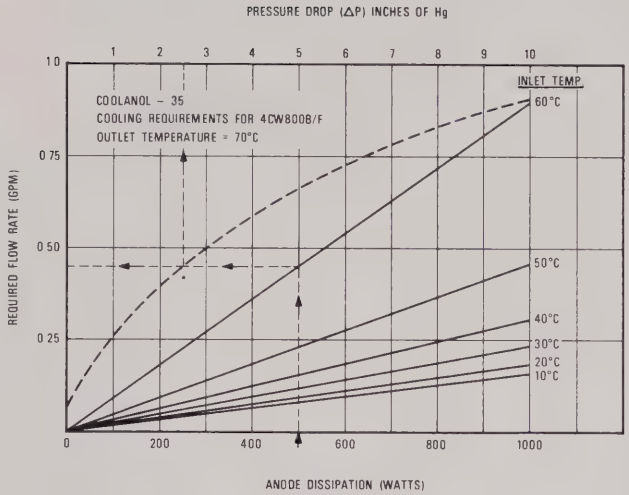
At higher temperatures, base cooling may be required to maintain base temperatures below 150°C. This can be accomplished by mounting the tube to a cold plate cooled by the inlet liquid.

WATER COOLING - The tabulation below lists the minimum water flow requirements for 25°C inlet water temperature with a temperature rise of 15°C from inlet to outlet.

Plate Dissipation (Watts)	Water Flow (GPM)	Pressure Drop (psi)
200	.050	.025
400	.100	.050
600	.156	.075
800	.202	.100

Water pressure should never exceed 200 psi and outlet temperature must be limited to 70°C.

OIL COOLING - The cooling jacket was specifically designed for oil coolant such as Coolanol 35. The minimum flow requirement and pressure drop can be derived from the following graph:



* Sample Calculation: For an inlet temperature of 60°C at 500 watts anode dissipation, the required flow rate is .45 GPM. The pressure drop will be .25 inches of Hg.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness.

ELECTRICAL

HEATER - The rated heater voltage is 6.0 volts for the 4CW800B and 26.5 volts for the 4CW800F. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than three minutes before current is drawn from the cathode. Tube operation will stabilize after a period of approximately five minutes from a cold start.

CONTROL-GRID OPERATION - The control-grid has a maximum dissipation of 3.0 watts and precautions should be observed to avoid exceeding this rating. Derating of the control grid dissipation will be necessary if the base flange temperature exceeds 150°C.

There are four threaded grid pins on the base of the tube. These pins can be used separately or in parallel to control the amount of grid lead in-

ductance to suit the requirements of the circuit. The grid lead inductance for one pin is 2.4 nanohenries.

SCREEN GRID OPERATION - The maximum rated screen dissipation for the 4CW800B or 4CW800F is 15 watts.

Under certain operating conditions the screen current of a tetrode may reverse as indicated on the screen current meter. This condition is the result of secondary emission from the screen and is normal for a power tetrode. If the impedance of the screen power supply is high, negative screen current will cause the screen voltage to approach the anode voltage, and the results will be a runaway condition which could lead to a catastrophic failure. This condition can be avoided if sufficient bleeder current is drawn from the screen supply by an appropriate bleeder or regulator tube. The recommended bleeder current for these tubes is 20 mA for each tube connected to a common screen power supply.

A low inductance screen bypass capacitor, EIMAC SK-680, is available for either tube. This capacitor is easily installed with six 0-80 screws. With the SK-680 capacitor installed, the screen self-resonant frequency of either tube is in excess of 900 MHz.

PLATE OPERATION - The maximum rated plate dissipation power for either tube is 800 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded. Connection to the anode is accomplished by a clamp around the anode.

DISTRIBUTED AMPLIFIER SERVICE - The mechanical and electrical features of the 4CW800B and 4CW800F are compatible with distributed amplifier circuit requirements, combining the qualities of low lead inductance, low input and output capacitances, high transconductance, and small size. Connection is made to the control grid by means of four threaded studs. By using the correct number of connections, the designer has available a choice of several values of grid lead inductance. This feature is quite useful in design of VHF/UHF distributed amplifiers. In addition, rugged internal tube construction, consisting of a unitized electrode structure and a solid direct-chassis flange mount, are features which make these tubes suitable for environments exhibiting severe shock and vibration, such as encountered in mobile or airborne service.

A distributed amplifier is a wideband, cascade device, employing vacuum tubes placed along an artificial transmission line, the tube capacitances appearing as the shunt elements of the line. In a properly designed distributed amplifier, the driving impedance is virtually independent of the number of tubes. The amplifier may make use of the characteristics of the low pass, the band pass, or the high pass filter configuration.

The 4CW800B and 4CW800F are ideal tubes for distributed amplifier service, as anode heat may be readily disposed of by a compact, external cooling system. An amplifier using one of these types is an advantage in instantaneous bandwidth rf systems as it eliminates the need of complex and slow tuning and tracking equipment necessary for a tuned amplifier.

EIMAC APPLICATION BULLETIN NUMBER FOURTEEN - This 23-page booklet is available from EIMAC and contains additional information on the use of these tubes (or similar types of the same tube family), including some constructional details, in strip-line amplifier circuitry in the 140-250 MHz range, distributed amplifier service, and cavity amplifier operation at 432 MHz and 865 MHz.

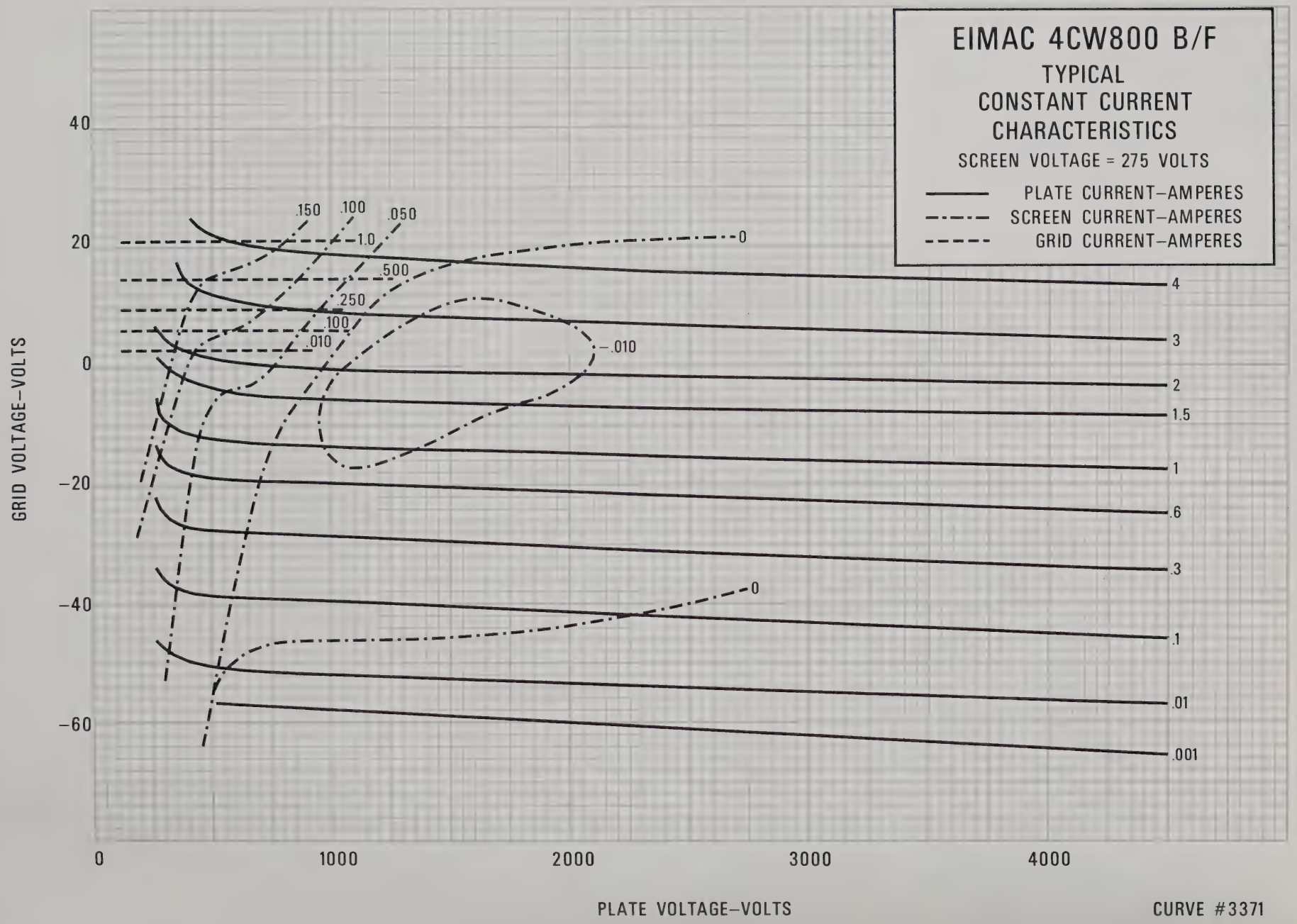
HIGH VOLTAGE - The 4CW800B and 4CW800F operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

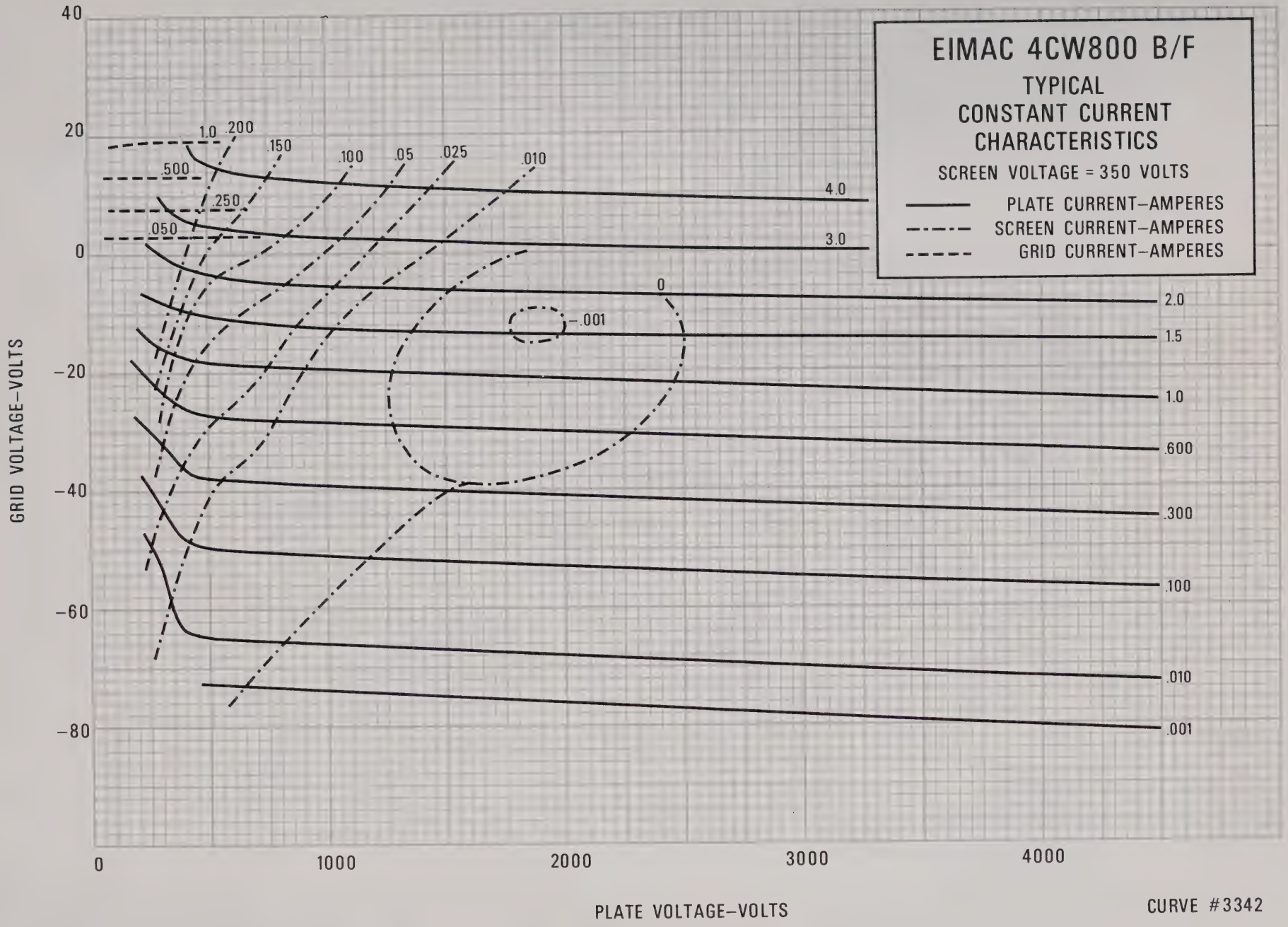
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

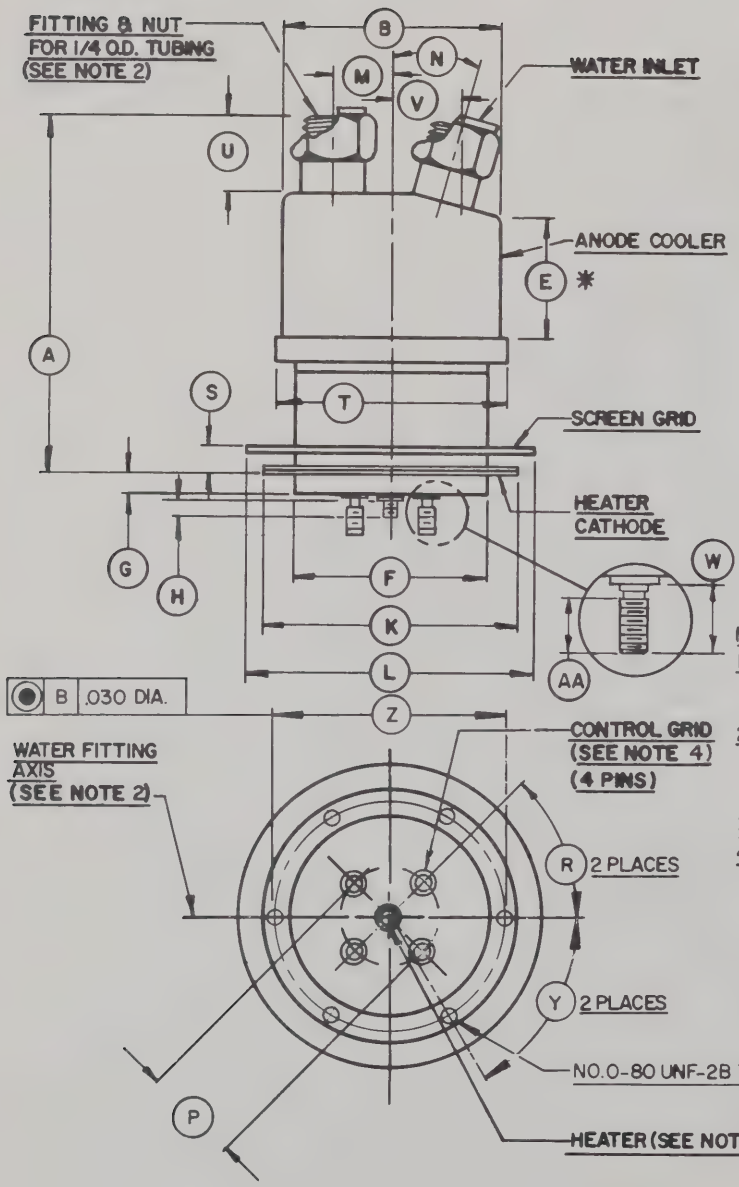
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


EIMAC 4CW800 B/F
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 275 VOLTS
PLATE CURRENT–AMPERES
SCREEN CURRENT–AMPERES
GRID CURRENT–AMPERES
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–VOLTS
CURVE #3371
40
20
0
−20
−40
−60
0
1000
2000
3000
4000
.150
.100
.050
1.0
.500
.250
.100
.010
−.010
0
4
3
2
1.5
1
.6
.3
.1
.01
.001
0


EIMAC 4CW800 B/F
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 350 VOLTS
PLATE CURRENT–AMPERES
SCREEN CURRENT–AMPERES
GRID CURRENT–AMPERES
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–VOLTS
CURVE #3342
40
20
0
−20
−40
−60
−80
0
1000
2000
3000
4000
1.0
.200
.150
.100
.05
.025
.010
.500
.250
.050
4.0
3.0
0
−.001
2.0
1.5
1.0
.600
.300
.100
.010
.001



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	2.515	- -	- -	63.88	- -
B	1.485	1.515	- -	37.35	38.10	- -
E	0.650	- -	- -	16.35	- -	- -
F	1.305	1.325	- -	32.82	33.32	- -
G	0.130	0.155	- -	3.27	3.90	- -
H	0.130	0.180	- -	3.27	4.53	- -
K	1.710	1.750	- -	43.01	44.01	- -
L	1.930	2.025	- -	48.54	50.93	- -
M	0.435	0.475	- -	10.94	11.95	- -
N	15°	25°	- -	15°	25°	- -
P	0.550	0.600	- -	13.97	15.24	- -
R	44°	46°	- -	44°	46°	- -
S	0.180	0.220	- -	4.53	5.53	- -
T	1.550	1.610	- -	38.98	40.48	- -
U	0.400	- -	- -	10.06	- -	- -
V	0.440	0.520	- -	11.07	13.08	- -
W	0.250	0.300	- -	6.29	7.54	- -
Y	59°	61°	- -	59°	61°	- -
Z	1.608	1.628	- -	40.84	41.35	- -

NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD FOR INSP. PURPOSES.
2. WATER FITTINGS ARE DIA-METRICALLY OPPOSED & AXIS IS LOCATED BETWEEN AXES OF PINS.
3. (*) CONTACT SURFACE.
4. 2-56 UNC-2A.

8281
4CX15,000A

TECHNICAL DATA

RADIAL BEAM
POWER TETRODE

The EIMAC 8281/4CX15,000A is a ceramic/metal power tetrode intended for use in audio or radio frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 8281/4CX15,000A at full ratings up to 110 MHz, and at reduced ratings, to 225 MHz.

The 8281/4CX15,000A is also recommended for radio-frequency linear power amplifier service, and for VHF television linear amplifier service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor, average	
Grid to Screen	4.5
Direct Interelectrode Capacitances (cathode grounded):[2]	
Cin	160.0 pF
Cout	24.5 pF
Cgp	1.5 pF
Direct Interelectrode Capacitances (grid and screen grounded):[2]	
Cin	67.0 pF
Cout	25.5 pF
Cpk	0.2 pF
Maximum Frequency Ratings	
CW	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.375 in; 238.13 mm
Diameter	7.580 in; 192.53 mm
Net Weight	12.8 lb; 5.81 kg
Operating Position	Axis vertical, base up or down
Cooling	Forced air
Operating Temperature, maximum	
Ceramic/Metal Seals and Anode Core	250°C
Base	Special, concentric
Recommended Air System Socket	SK-300A
Recommended Air Chimney	SK-316

(Revised 12-15-73) © 1971 by Varian Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, Class AB_1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
Peak Envelope or Modulation Crest Conditions

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current	1.0	1.0	Adc
Single-Tone Plate Current	4.0	4.25	Adc
Single-Tone Screen Current [2]	170	150	mAdc
Peak rf Grid Voltage [2]	330	340	v
Plate Dissipation	12.2	14.0	kW
Single-Tone Plate Output Power	20.8	28.5	kW
Resonant Load Impedance	865	1,260	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-510	-550	Vdc
Plate Current	4.65	4.55	Adc
Screen Current [1]	0.59	0.54	Adc
Grid Current [1]	0.30	0.27	Adc
Peak rf Grid Voltage [1]	730	790	v
Calculated Driving Power	220	220	W
Plate Dissipation	8.1	9.0	kW
Plate Output Power	26.7	36.5	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER
GRID DRIVEN Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION

Plate Voltage	6,000	8,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-640	Vdc
Plate Current	3.75	3.65	Adc
Screen Current [1]	0.45	0.43	Adc
Grid Current [1]	0.18	0.18	Adc
Peak af Screen Voltage [1] 100% modulation	740	710	v
Peak rf Grid Voltage [1]	800	840	v
Calculated Driving Power	150	150	W
Plate Dissipation	5.1	5.8	kW
Plate Output Power	17.4	23.5	kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
GRID DRIVEN, Class AB_1 (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	10,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION (Two tubes)

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current [3]	1.00	1.00	Adc
Maximum Signal Plate Current	8.80	8.50	Adc
Maximum Signal Screen Current [2]	0.34	0.30	Adc
Peak af Grid Voltage [2]	330	340	v
Maximum Signal Plate Dissipation [3]	12.2	14.0	kW
Plate Output Power	41.6	57.0	kW
Load Resistance (plate to plate)	1,730	2,520	Ω

1. Adjust for specified zero-signal plate current.
2. Approximate value.
3. Per Tube.

TELEVISION LINEAR AMPLIFIER
Cathode Driven

ABSOLUTE MAXIMUM RATINGS

110 MHz to 225 MHz

DC PLATE VOLTAGE	6500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
SCREEN DISSIPATION	450	WATTS
GRID DISSIPATION	200	WATTS

TYPICAL OPERATION, Composite Signal Black Level Unless Otherwise Stated

Plate Voltage	5000	6000	Vdc
Screen Voltage	500	700	Vdc
Grid Voltage [1]	-160	-180	Vdc
Plate Current (zero sig.)	.500	.650	Adc
Plate Current	2.800	3.335	Adc
Grid Current	.075	.035	Adc
Screen Current	.060	.040	Adc
Peak Cath. Volt. (pk synch.)	310	345	v
Cath. Driving Power (pk. synch.)	975	1350	w
Plate Output Power (pk. synch.)	11.0	16.5	kw
Plate Load Resistance	600	600	Ω

1. Approximate value.

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	152	168	A
Interelectrode Capacitances, cathode grounded [1]			
Cin	154.0	167.0	pF
Cout	22.0	27.0	pF
Cgp	----	2.0	pF
Interelectrode Capacitances, grid and screen grounded [1]			
Cin	62.0	72.0	pF
Cout	23.0	28.0	pF
Cpk	----	0.3	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

MOUNTING - The 4CX15,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CX15,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through the SK-316 Air Chimney, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX15,000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). This data is for the tube mounted in an SK-300A socket with an SK-316 chimney.

APPLICATION

SEA LEVEL			10,000 FEET	
Plate Dissipation * (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
7,500	230	.7	336	1.0
12,500	490	2.7	710	4.1
15,000	645	4.6	945	7.0

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX15,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX15,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

GRID OPERATION - The 4CX15,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX15,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX15,000A is 15,000 watts.

When the 4CX15,000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000 watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with the 4CX15,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX15,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CX 15,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry --- the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

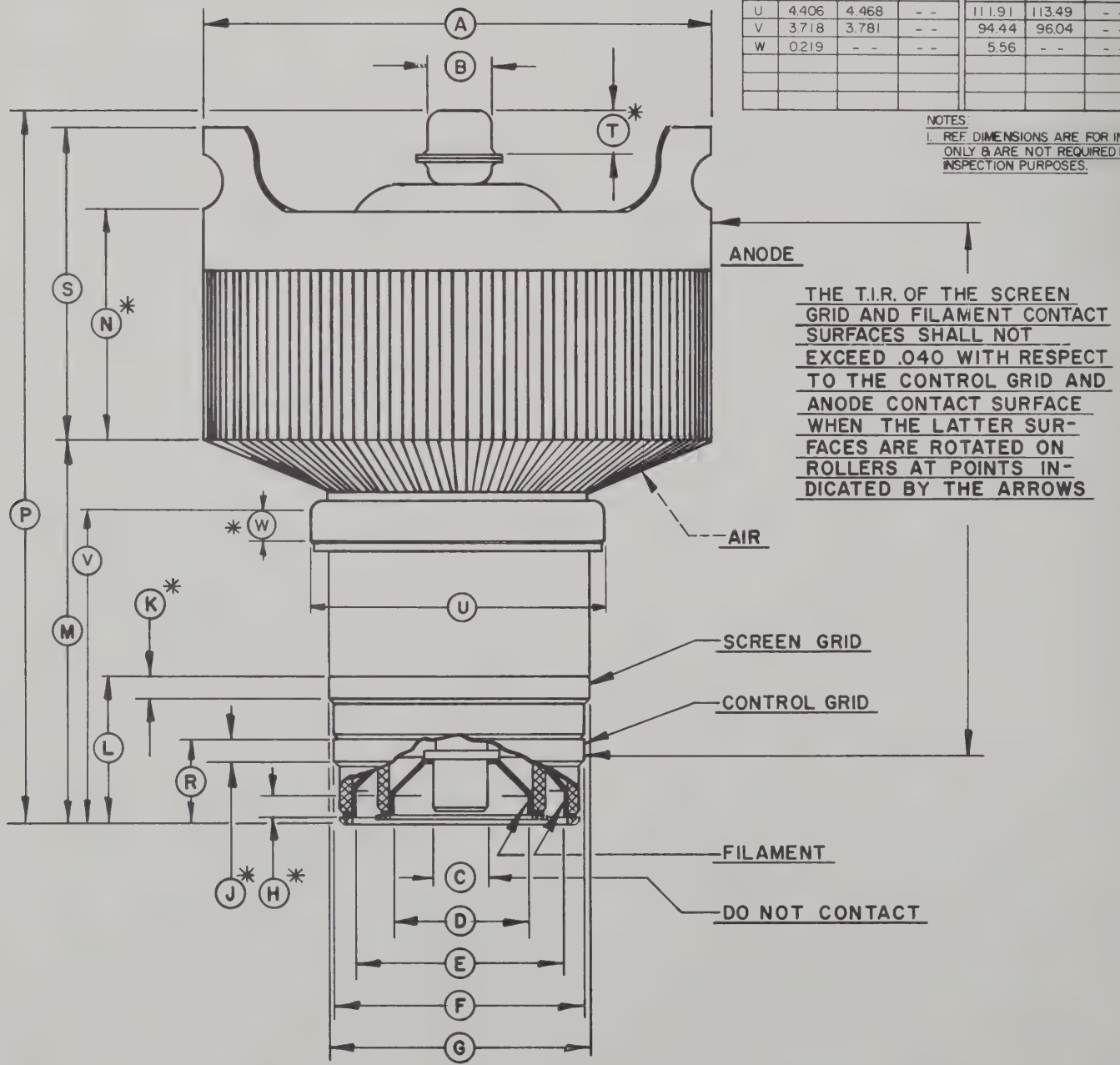
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for information and recommendations.

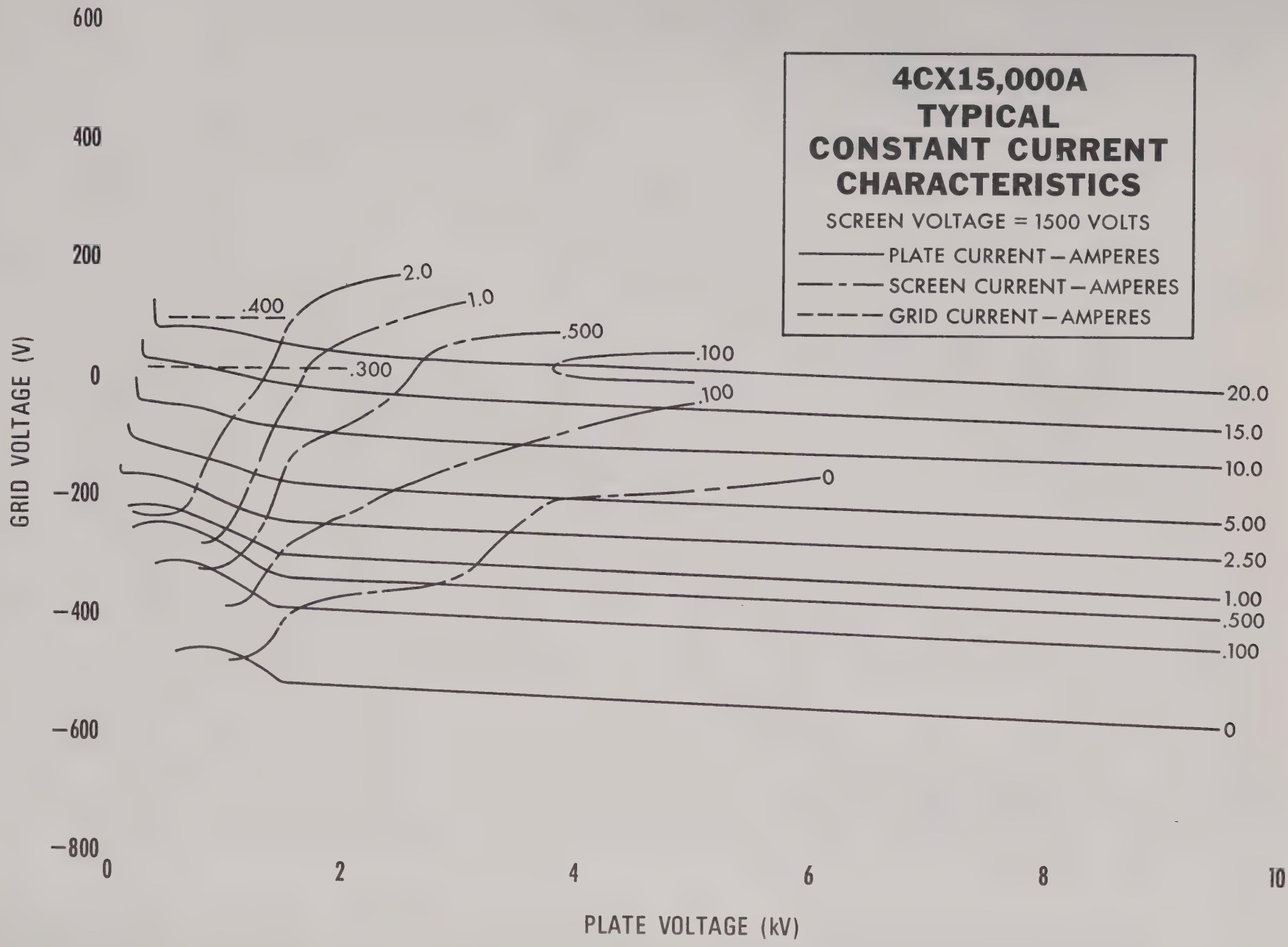
DIMENSIONAL DATA

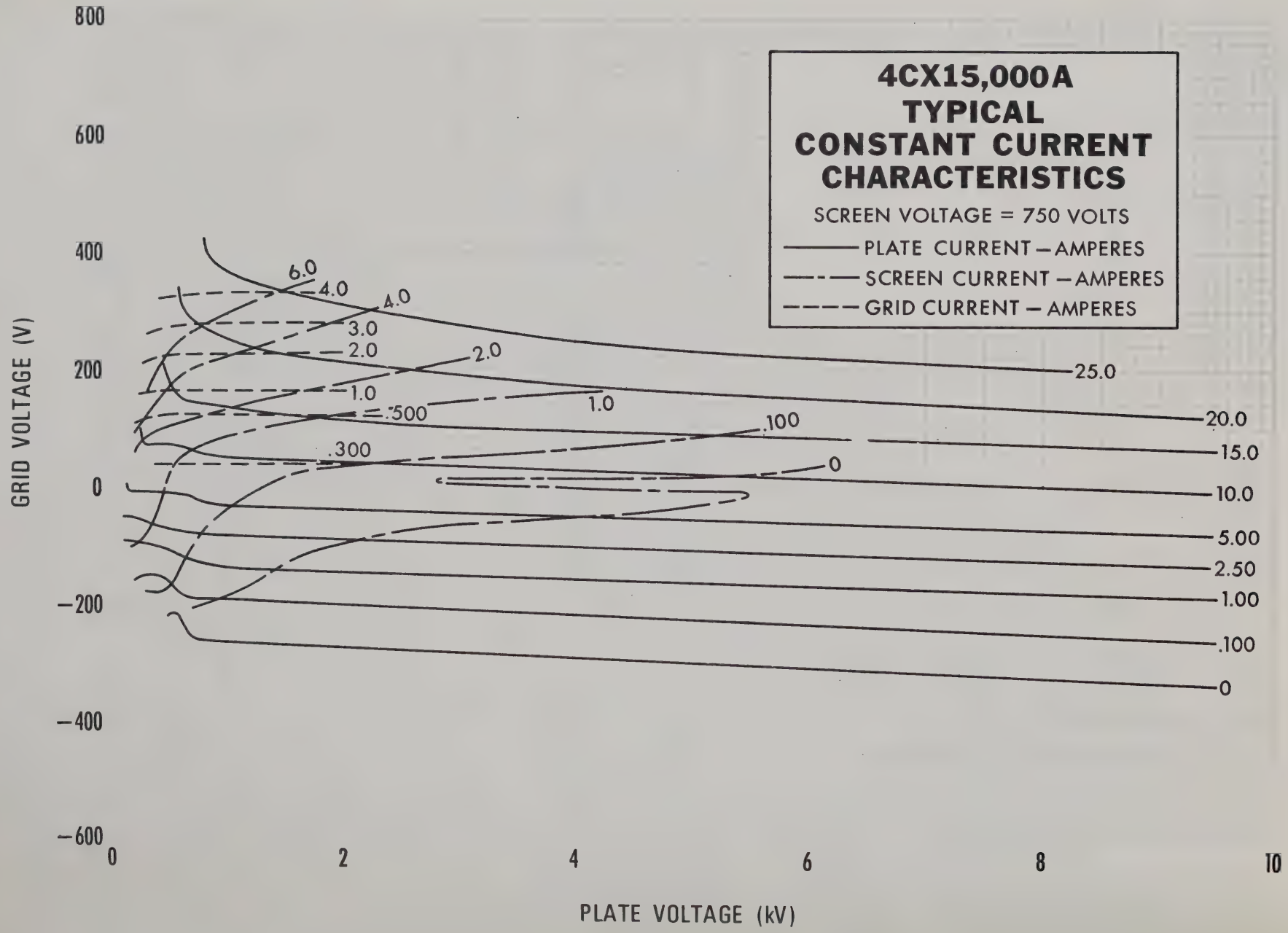
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.460	7.580	- -	189.48	192.53	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	46.63	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
K	0.188	- -	- -	4.78	- -	- -
L	1.764	1.826	- -	44.81	46.38	- -
M	4.659	4.783	- -	118.34	121.49	- -
N	2.412	2.788	- -	61.26	70.82	- -
P	9.000	9.375	- -	228.60	238.13	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.560	3.684	- -	90.42	93.57	- -
T	0.375	- -	- -	9.53	- -	- -
U	4.406	4.468	- -	111.91	113.49	- -
V	3.718	3.781	- -	94.44	96.04	- -
W	0.219	- -	- -	5.56	- -	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



* CONTACT SURFACE


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
600
400
200
0
−200
−400
−600
−800
PLATE VOLTAGE (kV)
0
2
4
6
8
10
2.0
1.0
.500
.100
.400
.300
.100
0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
PLATE VOLTAGE (kV)
6.0
4.0
4.0
3.0
2.0
2.0
1.0
1.0
.500
.300
.100
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0

TECHNICAL DATA

8249
4W300B

RADIAL BEAM
POWER TETRODE

The EIMAC 8249/4W300B is a ceramic/metal, water cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 300 watts and a maximum power input rating of 500 watts. The 8249/4W300B is designed to operate with a heater voltage of 6.0 volts. Electrically identical to the 4CX250B, it is intended for use where water cooling is preferred or where reserve anode dissipation is desired.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.6	A
Cathode - Heater Potential	±150	V
Transconductance (Average):		
I_b = 200 mAdc	12,000	μmhos
Amplification Factor (Average):		
Grid to Screen	5.0	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Input	15.7	pF
Output	4.5	pF
Feedback	0.04	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Input	13.0	pF
Output	4.5	pF
Feedback	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	3.407 in; 86.54 mm
Diameter	1.562 in; 39.67 mm
Net Weight	5.75 oz; 163.0 gm
Operating Position	Vertical, base up or down

(Revised 11-1-73) © 1970, 1973 by Varian

Printed in U.S.A.

Maximum Operating Temperature:
Ceramic/Metal Seals . . . . . 250°C
Cooling . . . . . Water and forced air
Base . . . . . Special 9-pin JEDEC-B8-236
Recommended Air System Socket . . . . . SK-600 series

MAXIMUM RATINGS:	Class C Plate Mod	Class C CW or FM	Class AB Audio or SSB	
DC PLATE VOLTAGE . . .	1500	2000	2000	VOLTS
DC SCREEN VOLTAGE . .	300	300	400	VOLTS
DC GRID VOLTAGE . . .	-250	-250	-250	VOLTS
DC PLATE CURRENT . . .	0.20	0.25	0.25	AMPERE
PLATE DISSIPATION . . .	200	300	300	WATTS
SCREEN DISSIPATION . .	12	12	12	WATTS
GRID DISSIPATION . . .	2	2	2	WATTS

TYPICAL OPERATION:	DC Plate Voltage (Volts)	Power Input (Watts)	Driving Power (Watts)	Power Output (Watts)
CLASS C AMPLIFIER				
CW or FM	2000	500	3	390
Plate Modulated	1500	300	2	235
CLASS AB_1 AMPLIFIER				
Audio (Two tubes)	2000	1000	0	600
SSB (One tube)	2000	500	0	300

For full listing of ratings, constant current curves and typical operating conditions, see EIMAC data sheet for 7203/4CX250B.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater: Current at 6.0 volts	2.3	2.9	A
Cathode Warmup Time	30	--	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Input	14.2	17.2	pF
Output	4.0	5.0	pF
Feedback	---	0.06	pF

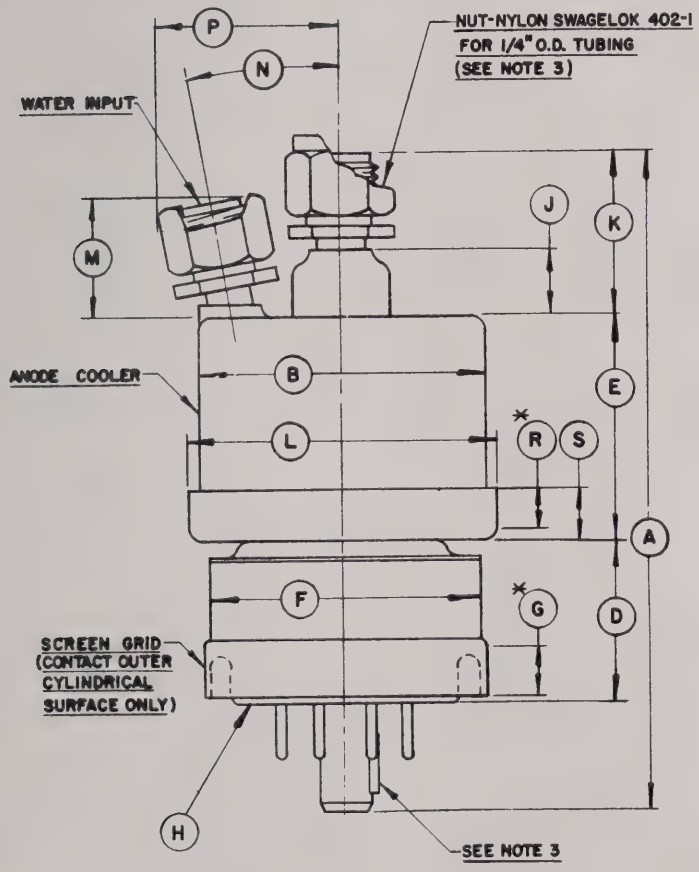
1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

COOLING - The water-cooled anode requires a minimum of 1/16 gallon of cooling water per minute for the rated plate dissipation of 300 watts. The outlet-water temperature should not exceed 70°C and the system pressure should not exceed 50 pounds per square inch.

The ceramic/metal seals must be cooled by forced air. At frequencies below 30 MHz and when one of the recommended sockets is used, a flow rate of 1.0 CFM is sufficient. As the operating frequency is increased, the air-flow rate must be increased. At 500 MHz a minimum of 3.8 CFM is required. In all cases, seal temperatures are the criteria which determine cooling effectiveness.

PIN NO. 1. SCREEN GRID
PIN NO. 2. CATHODE
PIN NO. 3. HEATER
PIN NO. 4. CATHODE
PIN NO. 5. I.C.-DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6. CATHODE
PIN NO. 7. HEATER
PIN NO. 8. CATHODE
CENTER PIN - CONTROL GRID



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	3.407	- -	- -	86.54	- -
B	1.450	1.490	- -	36.83	37.85	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	1.106	1.186	- -	28.09	30.12	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: B8-236 (JEDEC DESIGNATION)					
J	- -	- -	0.244	- -	- -	6.20
K	0.797	0.857	- -	20.24	21.77	- -
L	- -	1.562	- -	- -	39.67	- -
M	- -	- -	0.670	- -	- -	17.02
N	- -	- -	10°	- -	- -	10°
R	0.156	- -	- -	3.96	- -	- -
S	- -	- -	0.250	- -	- -	6.35
P	- -	1.063	- -	- -	27.00	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE
3. AXIS OF FITTINGS IS ON AXIS OF INDEX OF CENTER PIN AS SHOWN.

TECHNICAL DATA

8172
4X150G

RADIAL-BEAM POWER TETRODE

The EIMAC 8172/4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-voltage. The combination of a high ratio of transconductance to capacitance and a plate dissipation capability of 250 watts makes the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megahertz, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megahertz an output power of 50 watts per tube is obtained with a power-gain of five.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-heater Potential			150	volts
Heater: Voltage		2.5		volts
Current	6.2		7.3	amperes
Amplification Factor (Grid-to-Screen)		5		

Direct Interelectrode Capacitances, Grounded Cathode:	*Min.*	*Max.*	
Input	25.0	29.0	pf
Output	4.0	4.9	pf
Feedback		0.05	pf
Direct Interelectrode Capacitances, Grounded Grid and Screen	*Min.*	*Max.*	
Input	14.5	19	pf
Output	4.0	4.9	pf
Feedback		0.01	pf

Frequency for Maximum Ratings (CW)	500 MHz
(pulsed)	1500 MHz

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175°C
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Maximum Dimensions:	
Height	2.75 inches
Diameter	1.635 inches
Cooling	Forced Air
Net Weight	6 ounces
Shipping Weight (Approximate)	1.6 pounds

(Revised 10-15-73)© 1959, 1966, 1973 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	600	750	1000	1250	1250	volts
DC Screen Voltage	250	250	250	250	250	volts
DC Grid Voltage	—75	—80	—80	—90	—80	volts
DC Plate Current	200	200	200	200	200	mA
DC Screen Current*	37	37	30	20	7	mA†
DC Grid Current*	10	10	10	10	10	mA†
Peak RF Grid Voltage*	90	95	95	105	—	volts
Driving Power*	0.7	0.7	0.7	0.8	10	watts†
Plate Input Power	120	150	200	250	250	watts
Plate Output Power	85	110	150	195	140	watts†

*Approximate values.
†Measured values for a typical cavity amplifier circuit.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	600	800	1000	volts
DC Screen Voltage	250	250	250	volts
DC Grid Voltage	—95	—100	—105	volts
DC Plate Current	200	200	200	mA
DC Screen Current*	35	25	20	mA
DC Grid Current*	8	10	15	mA
Peak RF Grid Input Voltage*	120	120	125	volts
Driving Power*	1	1.5	2	watts
Plate Input Power	40	60	60	watts
Plate Output Power	120	160	200	watts

*Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	250 VOLTS
DC PLATE CURRENT (Average)	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION
(Frequencies up to 216 MHz, 5-MHz bandwidth)

DC Plate Voltage	750	1000	1250	volts
DC Screen Voltage	300	300	300	volts
DC Grid Voltage	—60	—65	—70	volts
During Sync-Pulse Peak:				
DC Plate Current	335	330	305	mA
DC Screen Current	50	45	45	mA
DC Grid Current	15	20	25	mA
Peak RF Grid Voltage	85	95	100	volts
RF Driving Power (approx.)	7	8	9	watts
Useful Power Output	135	200	250	watts
Black Level:				
DC Plate Current	245	240	230	mA
DC Screen Current	20	15	10	mA
DC Grid Current	4	4	4	mA
Peak RF Grid Voltage (approx.)	65	70	75	volts
RF Driver Power (approx.)	4.25	4.7	5.5	watts
Plate Power Input	185	240	290	watts
Useful Power Output	75	110	140	watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 VOLTS
PULSED SCREEN VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	—500 VOLTS
PULSE DURATION	5 USEC
PULSED CATHODE CURRENT	7 AMPS
AVERAGE POWER INPUT	250 WATTS
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL PULSE OPERATION
Single tube oscillator, 1200-MHz

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Current	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	—200	—250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 μsec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz
peak-envelope conditions except where noted)

DC Plate Voltage	1000	1250	volts
DC Screen Voltage	350	350	volts
DC Grid Voltage*	—55	—55	volts
Zero-Signal DC Plate Current	100	100	mA
Peak RF Grid Voltage**	50	50	volts
DC Plate Current	250	250	mA
DC Screen Current**	10	9	mA
Plate Input Power	250	310	watts
Plate Output Power	120	170	watts
Two-Tone Average DC Plate Current	190	190	mA
Two-Tone Average DC Screen Current**	2	—1	mA

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X150G may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling — The 4X150G requires sufficient forced air to keep the glass-to-metal seals below 175°C and the ceramic-metal seals and anode core below 250°C. The air flow must be started when power is applied to the heater and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 175°C and the center heater terminal below 250°C.

The air requirements stated above are based on operation at sea level an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow.

Temperature of the external parts of a tube may be measured with the aid of a temperature-sensitive lacquer.

ELECTRICAL

Heater — The rated heater voltage for the 4X150G is 2.5 volts, and should be maintained at this value plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C CW amplifier, the heater voltage should be reduced according to the following table.

Frequency	Heater Voltage
301 to 400 MHz	2.4 volts
401 to 500 MHz	2.3 volts

At low duty, in pulse service, no reduction in heater voltage is normally required up to 1500 MHz.

Cathode — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation — The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected

between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150G.

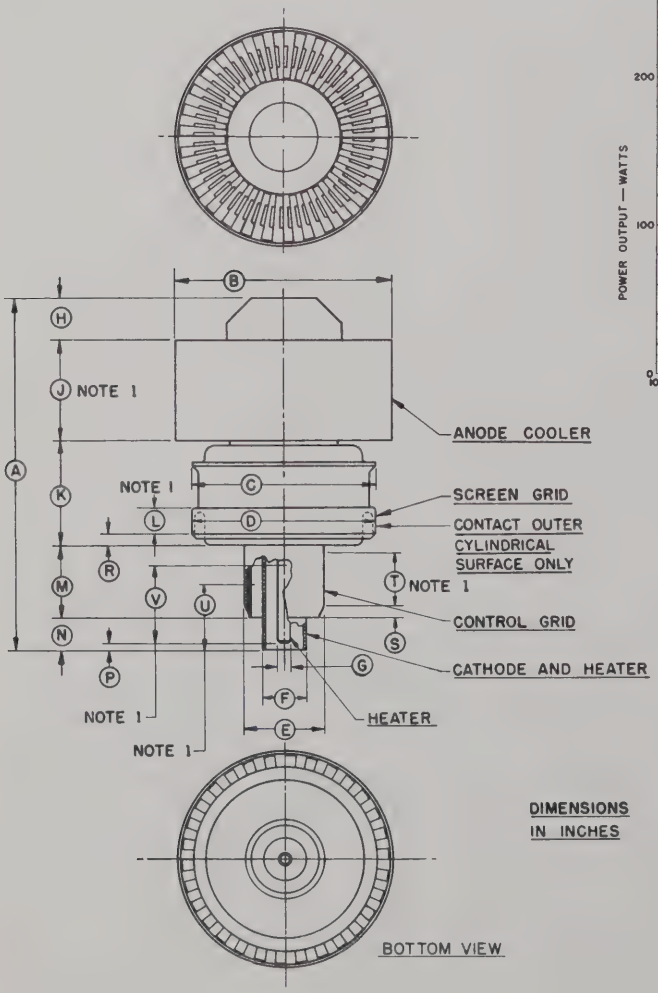
Plate Operation — The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

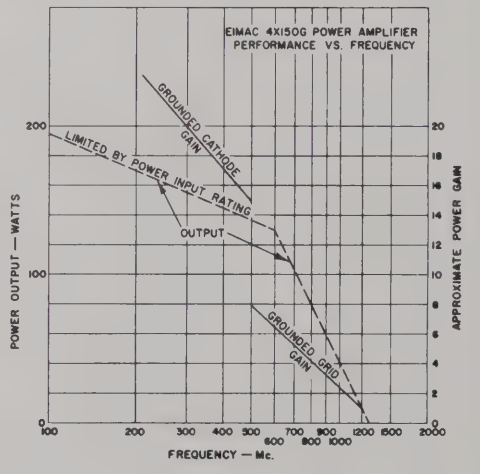
UHF Operation — The 4X150G is suitable use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

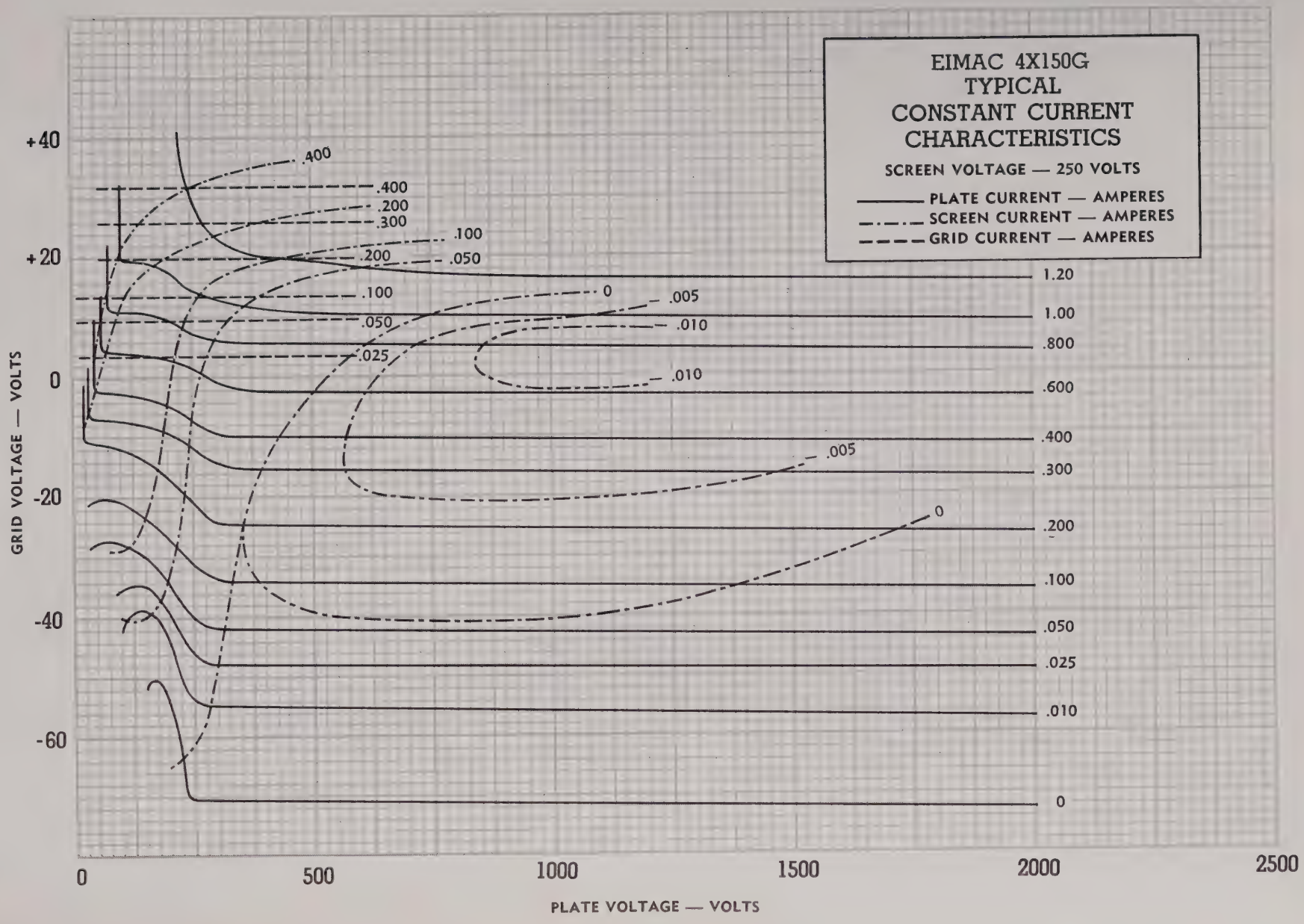
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

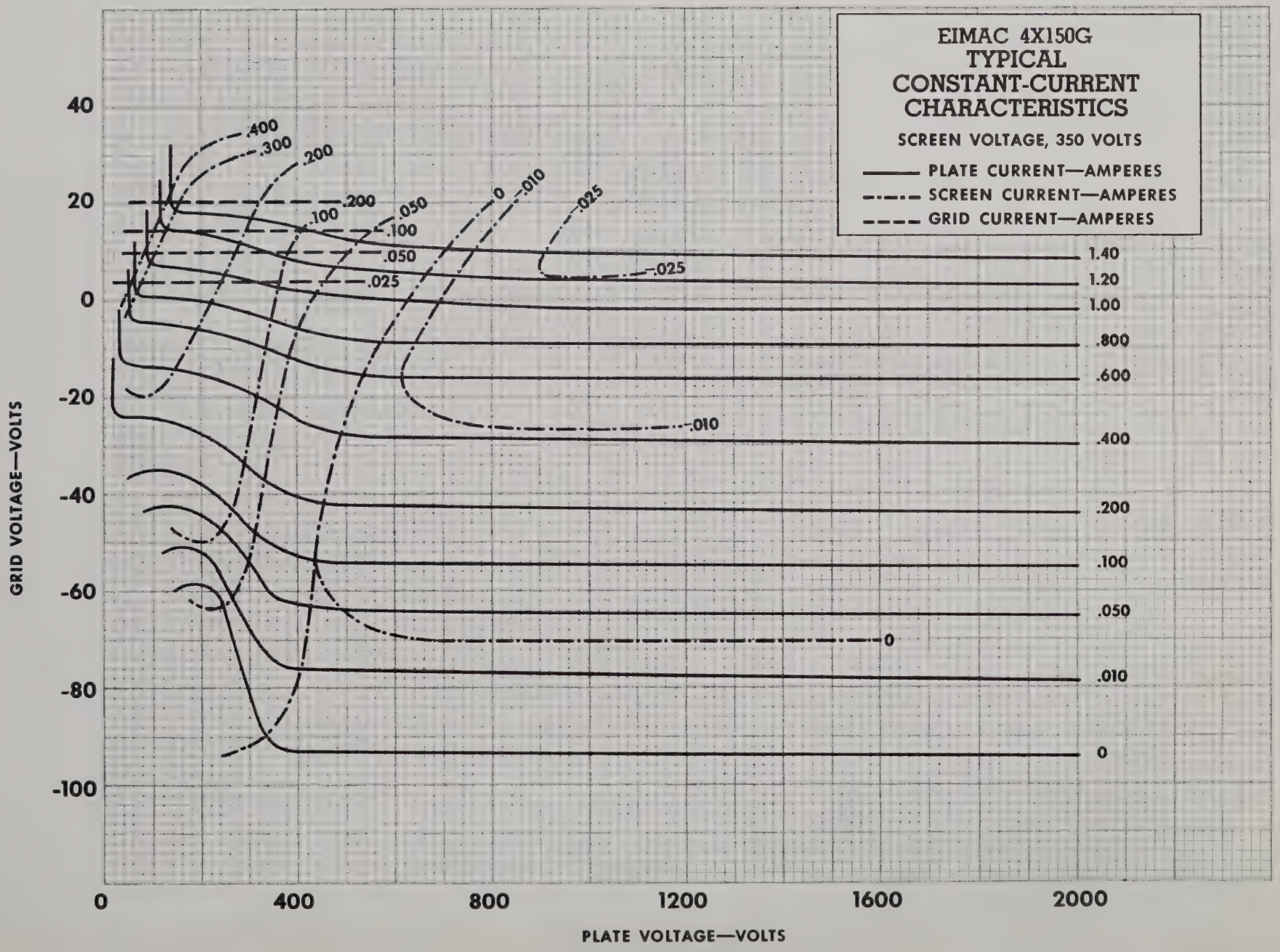




DIMENSION			
REF	NOMINAL	MINIMUM	MAXIMUM
A			2 3/4
B		1.615	1.635
C			1.406
D		1.417	1.433
E		.587	.597
F		.317	.327
G		.088	.098
H			5/16
J		23/32	25/32
K		3/4	13/16
L		3/16	
M		.500	.578
N		15/64	17/64
P		1/32	1/16
R	3/32		
S	1/8		
T		11/32	
U		13/32	
V		15/32	

NOTE 1. LENGTH AVAILABLE FOR CONTACT.


EIMAC 4X150G
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
+40
+20
0
-20
-40
-60
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.200
.300
.100
.200
.050
.100
.050
.025
.010
0
.005
.010
.005
0


EIMAC 4X150G
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
.200
.100
.050
.025
.050
.100
.200
0
.010
.025
.025
.010
0

8930

TECHNICAL DATA

RADIAL BEAM
POWER TETRODE

The EIMAC 8930 is a compact, high-perveance tetrode with a maximum plate dissipation of 350 watts. It is electrically identical to the EIMAC 7589W/4CX250R but the larger anode radiator assembly allows higher dissipation with low air flow and pressure drop characteristics.

The tube has rugged internal construction features for reliable operation under heavy shock or vibration conditions.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated, Unipotential

Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	2.6 A
Frequency of Maximum Rating	500 MHz
Amplification Factor (Average):	
Grid to Screen	5
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	17.5 pF
Cout	4.9 pF
Cgp	0.04 pF

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special 9-pin, JEDEC B8-236
Recommended Air-System Socket	EIMAC SK-600 Series
Recommended Air-System Chimney	EIMAC SK-646
Maximum Overall Dimensions:	
Length	2.46 in; 62.59 mm
Diameter	2.08 in; 52.83 mm
Operating Position	Any
Cooling	Forced Air
Net Weight (Approximate)	5.5 oz; 156 gm
Maximum Operating Temperature:	
Anode Core & Ceramic/Metal Seals	250°C

(Effective 12-1-73) © by Varian

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB (SSB)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified zero-signal plate current.
2. Approximate; should be held above Absolute Maximum rating of 250 mAdc only for brief periods of tuning.
3. Approximate; rated screen dissipation should not be exceeded.
4. Approximate value.
5. The Intermodulation Distortion Products are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	Vdc
Screen Voltage	350	Vdc
Grid Voltage [1]	-63	Vdc
Zero-Signal Plate Current	90	mAdc
One-Tone Plate Current [2]	290	mAdc
Two-Tone Plate Current [4]	205	mAdc
One-Tone Screen Current [3]	30	mAdc
Two-Tone Screen Current [4]	7	mAdc
One-Tone Useful Output Power	350	W
Resonant Load Impedance	4000	Ω
Intermodulation Distortion Products [5]		
3rd Order	-27	dB
5th Order	-30	dB

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified value of zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Measured data at 400 MHz)
Class AB_1, Grid Driven

Plate Voltage	2000	Vdc
Screen Voltage	400	Vdc
Grid Voltage [1]	-85	Vdc
Zero-Signal Plate Current	70	mAdc
Plate Current, 65 W Carrier [2]	170	mAdc
Plate Current, 65 W Carrier [2] Modulated 90%	200	mAdc
Screen Current, 65 W Carrier	-10	mAdc
Peak Screen Current, 65 W Carrier Modulated 90% [2]	30	mAdc
Driving Power, 65 W Carrier	4	W

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified value of zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Two Tubes)
Class AB_1

Plate Voltage	2000	Vdc
Screen Voltage	350	Vdc
Grid Voltage [1]	-66	Vdc
Zero Signal Plate Current	140	mAdc
Max. Signal Plate Current	500	mAdc
Zero Signal Screen Current [2]	-4	mAdc
Max. Signal Screen Current [2]	+4	mAdc
Peak Driving Power	0	W
Load Resistance (plate-to-plate)	8000	Ω
Power Output (Trans. Eff. = 95%) [2]	595	W

ABSOLUTE MAXIMUM RATINGS FOR OTHER TYPES OF OPERATION

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER, GRID DRIVEN Class C Telephony (Carrier Conditions)

DC PLATE VOLTAGE	1800	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION	280	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

NOTE: TYPICAL OPERATION data is obtained from direct measurement. Adjustment of the rf grid voltage to obtain the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in screen current, which is incidental and which will vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct screen grid voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.
Heater: Current at 6.0 volts	2.3	2.9 A
Interelectrode Capacitances[1](grounded cathode):		
Cin	16.0	18.5 pF
Cout	4.2	5.2 pF
Cgp	---	0.06 pF

1. In a shielded fixture (see INTERELECTRODE CAPACITANCE)

APPLICATION

MECHANICAL

MOUNTING - The 8930 may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen bypass capacitors and may be obtained with either grounded or ungrounded cathode terminals. The SK-646 Air Chimney is also available.

When environmental stress (such as shock and/or vibration) is anticipated, special attention should be given to securing the tube, to prevent relative motion between the tube and socket during stress, as such motion could effect both the electrical and mechanical performance.

COOLING - Sufficient cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum value. Air requirements to maintain seal temperatures at 225°C in 50°C ambient air are shown. These values apply when the EIMAC SK-600 or SK-610 socket is used with the SK-646 chimney, with air flowing in the base-to-anode direction.

Minimum Cooling Air Flow Requirements				
Plate Dissipation (watts)	Sea Level		10,000 Feet	
	Air Flow (cfm)	Approx. Press.drop, In. H_2O	Air Flow (cfm)	Approx. Press.drop, In. H_2O
250	4.5	0.35	6.5	0.51
300	5.8	0.56	8.5	0.82
350	7.0	0.85	10.2	1.24

Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which may interfere with effective cooling.

The blower selected in any given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown, plus any drop encountered in ducts and filters, and the blower must be designed to deliver the air at the desired altitude.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperature is by the use of a temperature-sensitive lacquer or paint. When these materials are used, thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

SHOCK AND VIBRATION - The 8930 is recommended for applications where environmental stress is anticipated and reliable operation must be maintained under these circumstances. The tube structure is routinely tested at a vibration level of 10 G, over the frequency range of 28 to 2000 Hz, with full operating voltages applied, and also tested under 90 G long-duration (11 milliseconds) shock conditions, also with voltages

applied. When shock or vibration stressing is expected, it is extremely important that relative motion between socket and tube be prevented or restricted by clamping the tube into place.

ELECTRICAL

HEATER - The heater voltage for the 8930 is 6.0 volts and should be maintained within ±5% of rated value to minimize variations in performance and maximum life.

Above approximately 300 MHz some transit-time heating of the cathode will occur, and heater voltage should be lowered. For operation in the 300 to 400 MHz range, heater voltage should be 5.75 volts; in the 400 to 500 MHz range, 5.5 volts. Under no circumstances should heater voltage be allowed lower than 5.4 volts.

CATHODE OPERATION - The cathode is internally connected to the four even-numbered base pins, and all four corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep cathode leads short and direct and to use conductors with large areas to minimize inductive reactance in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts, regardless of polarity.

STANDBY OPERATION - When equipment is designed for very low-duty operation, where standby periods of many hours or even days at one time are anticipated, it is good engineering practice to include circuitry for reduction of the heater voltage of an oxide-cathode tube during the standby periods. This will greatly minimize the release of sublimation products within the tube. A reduction in heater voltage of 10% from the nominal value is recommended during such long standby periods, with simultaneous switching to normal voltage when the equipment is switched from STANDBY to OPERATE. A reduction in heater voltage of more than 10% is possible if operation is not attempted for several seconds after switching from the STANDBY to the OPERATE mode.

CONTROL GRID - The grid is rated for a maximum dissipation of 2 watts. The maximum dc bias voltage rating is -250 volts.

SCREEN-GRID OPERATION - The maximum rated power dissipation for the screen grid of the 8930 is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

If tuning of a linear amplifier circuit is to be done under single-tone conditions, extra care should be exercised to be sure the screen dissipation rating is not exceeded, as this is often the limiting factor during this type of operation.

Protection for the screen can be provided by an over-current relay and by interlocking the screen supply so the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from the screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

PLATE OPERATION - The maximum rated plate-dissipation power for the 8930 is 350 watts. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 Megahertz the top cap on the anode cooler may be used for a plate terminal. At higher frequencies a circular clamp or spring-finger collet encircling the outer surface of the anode cooler should be used.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize inputs. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube should fail.

UHF OPERATION - The 8930 is useful in the UHF region. Operation at these frequencies should be conducted with heavy plate loading and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

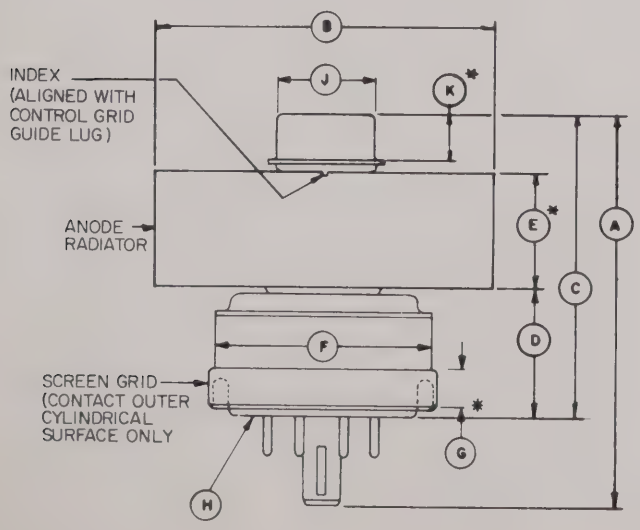
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 8930 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

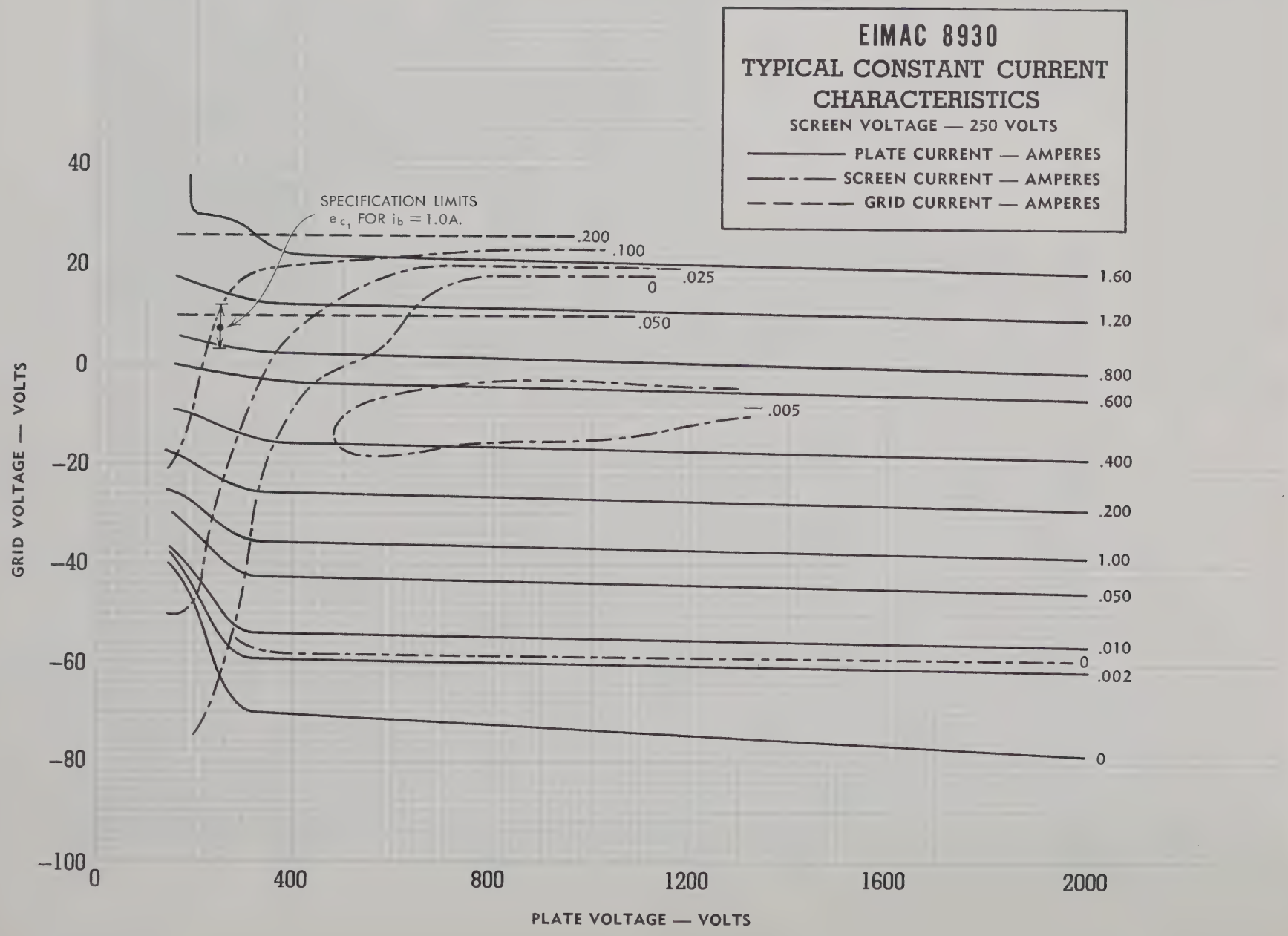
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

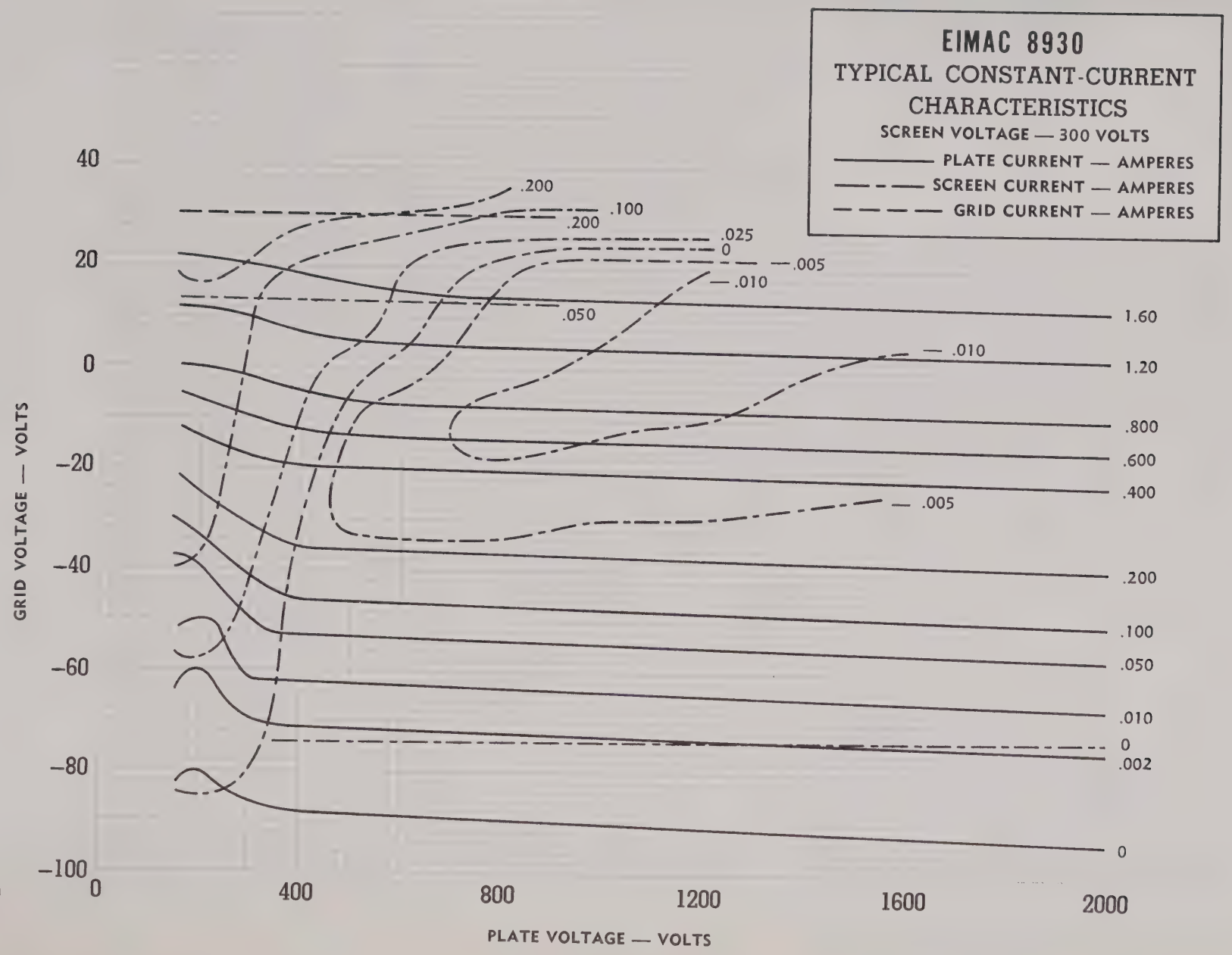
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

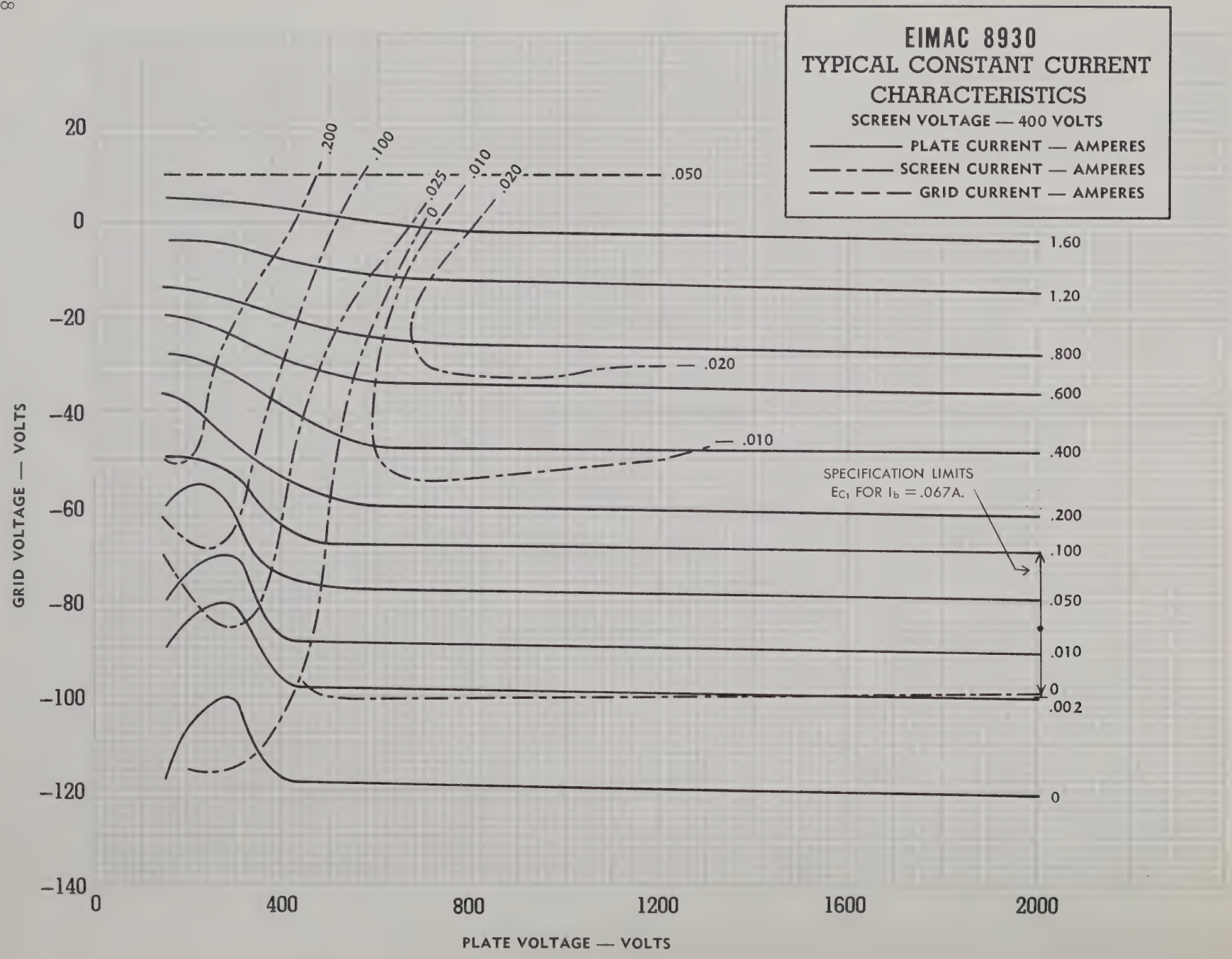


DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.324	2.464	- -	59.03	62.58	- -
B	2.050	2.080	- -	52.07	52.83	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: B8-236 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -

(*) CONTACT SURFACE


EIMAC 8930
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
.200
.100
.025
0
.050
.005
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
0
.002
0
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS


EIMAC 8930
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
.200
.100
.200
.025
0
.005
.010
.050
.010
.005
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
0


EIMAC 8930
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
20
0
−20
−40
−60
−80
−100
−120
−140
0
400
800
1200
1600
2000
.200
.100
.050
.025
.010
.020
0
.020
.010
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
0
SPECIFICATION LIMITS
E_{C_1} FOR I_b = .067A.

X-2159

TECHNICAL DATA

WATER-COOLED
POWER TETRODE

The EIMAC X-2159 is a ceramic/metal, water-cooled power tetrode designed for very-high-powered medium-frequency or high-frequency broadcast service and very-low-frequency communication in the megawatt power range.

The X-2159 has a two-section thoriated-tungsten filament mounted on water-cooled supports. The two sections may be fed in quadrature to reduce hum contributed by an ac power source. The maximum anode dissipation rating is 1250 kilowatts steady state.

Large-diameter coaxial terminals are used for the control grid and the three rf filament terminals. Filament power and filament support cooling-water connections are made through three special couplings with knurled and threaded clamping rings.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten, two-section	
Voltage per section	18.5 ± 0.9 V
Current at 18.5 V per section	700 A
Amplification Factor (Average), Grid to Screen	4.5
Direct Interelectrode Capacitance (grounded cathode)[2]:	
Cin	1650 pF
Cout	260 pF
Cgp	10 pF
Direct Interelectrode Capacitance (grounded grid)[2]:	
Cin	675 pF
Cout	260 pF
Cpk	1.0 pF
Frequency of Operation: for use above 30 MHz, contact: Product Manager, Power Grid Division, EIMAC Div. of Varian.	

1. The design of this tube is subject to change. The data supplied is for guidance only. Before establishing a final equipment design with this tube, contact: Product Manager, Power Grid Division, EIMAC Division of Varian.

2. Capacitance values shown are nominal, measured with no special shielding.

(Effective 7-1-73) © 1973 by Varian

Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	23.75 in; 60.32 cm
Diameter	17.03 in; 43.26 cm
Net Weight	175 lbs; 80 kg
Operating Position	Vertical, base down
Cooling	Water and Forced Air
Base Terminals	Special
Recommended Filament Connectors (not supplied with tube):	
Filament Power/Water Connector (3 required)	EIMAC X-2175
Filament rf Connector (1 required)	EIMAC X-2181
Maximum Operating Temperature:	
Envelope, and Ceramic/Metal Seals	200°C

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC PLATE CURRENT	125	AMPERES
PLATE DISSIPATION	1250	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB1, Peak Envelope Conditions

Plate Voltage	20.0	kVdc
Screen Voltage	1500	Vdc
Grid Voltage [1]	-380	Vdc
Zero Signal Plate Current	20.0	Adc
Single Tone Plate Current	86.5	Adc
Single Tone Screen Current [2]	3.8	Adc
Peak rf Grid Voltage [2]	380	v
Plate Dissipation	505	kW
Plate Load Resistance	132.2	Ω
Plate Power Output	1225	kW
Efficiency	70.8	%

1. Adjust to specified zero-signal plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

(Key-down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC PLATE CURRENT	125	AMPERES
PLATE DISSIPATION	1250	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	21.5	kVdc
Screen Voltage	1000	Vdc
Grid Voltage	-700	Vdc
Plate Current	125	Adc
Screen Current [1]	12	Adc
Grid Current [1]	7.2	Adc
Calculated Driving Power	7.0	kW
Plate Dissipation [1]	530	kW
Screen Dissipation [1]	12	kW
Grid Dissipation [1]	1.9	kW
Plate Load Resistance	85.5	Ω
Plate Power Output	2158	kW
Efficiency	80.1	%

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER Class C Telephony

(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17.5	KILOVOLTS
DC SCREEN VOLTAGE	2.0	KILOVOLTS
DC PLATE CURRENT	100	AMPERES
PLATE DISSIPATION	800	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	17.5	kVdc
Screen Voltage	1000	Vdc
Grid Voltage	-1000	Vdc
Plate Current	95.0	Adc
Screen Current [1]	8.0	Adc
Grid Current [1]	4.4	Adc
Pk. Screen Voltage (100% Mod)	1000	v
Pk. rf Grid Voltage	1280	v
Calculated Driving Power	6465	W
Plate Dissipation	279	kW
Screen Dissipation [1]	8.0	kW
Grid Dissipation [1]	2.05	kW
Plate Load Resistance	85.6	Ω
Plate Output Power	1384	kW
Efficiency	83.3	%

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB

ABSOLUTE MAXIMUM RATINGS (per tube):

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC PLATE CURRENT	125	AMPERES
PLATE DISSIPATION	1250	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION Two Tubes - Sinusoidal Wave

Plate Voltage	17.5	kVdc
Screen Voltage	1500	Vdc
Grid Voltage [1]	-455	Vdc
Zero Signal Plate Current	10	Adc
Max. Signal Plate Current	146.2	Adc
Max. Signal Screen Current [2]	7.8	Adc
Pk. Audio Freq. Grid Voltage [3]	455	v
Max. Signal Plate Dissipation [3]	275	kW
Plate/Plate Load Resistance	238.5	Ω
Plate Output Power	2015	kW

1. Adjust for stated zero-signal plate current.
2. Approximate value.
3. Per Tube.

NOTE: TYPICAL OPERATION data are obtained by calculation from the published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power then the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

APPLICATION

MECHANICAL

MOUNTING - The X-2159 must be mounted vertically, base down. The full weight of the tube should rest on the main screen-grid contact flange at the base of the tube, and all lifting of the tube should be done with the lifting eye which is attached to the top of the anode cooling jacket.

COOLING - It is essential that high purity water be used for anode cooling to minimize power loss and corrosion of metal fittings. Good distilled or de-ionized water will have a resistance of 1 to 2 megohms per cm^3. Water should be discarded if resistivity falls to 50,000 ohms/cm^3. Since the anode is normally

at high potential to ground, water connections to the anode are made through insulating tubing. These insulating sections should be long enough so that column resistance is above 100,000 ohms per 1000 plate supply volts. The table shows minimum anode cooling water requirements for several plate dissipation levels.

Plate Dissipation (Kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
500	130	15
800	205	30
1000	250	45
1250	310	66

This data is based on an inlet water temperature of 40°C and an outlet temperature of 70°C. In no case should the outlet water temperature be allowed to exceed 70°C, and system pressure should be limited to 85 PSI maximum.

Water cooling is also required for the screen grid, with a minimum flow of 2.0 GPM, at an approximate pressure drop of 25 PSI. The tube outline drawing shows which of the two connections should be used for inlet water.

Water cooling of the filament supports is required. Each of the three water connections includes both an inlet and outlet line, with the proper section for the inlet water shown on the outline drawing. Minimum flow for the F1 and F3 connectors should be 2.0 GPM, with an approximate pressure drop of 10 PSI for each connector; minimum flow for the F2 connector should be 4.0 GPM, with an approximate pressure drop of 55 PSI.

Base water cooling requirements can sometimes be simplified if the screen grid and filament connectors F1 and F3 are all cooled in series, with suitable insulation between terminals.

In addition to the water-cooling requirements, cooling air should be directed against the lower envelope surface, in the area of the ceramic/metal seals, and particularly from below, up into the recesses involving the control grid and screen grid contact surfaces. Under normal circumstances, a general purpose blower capable of supplying a minimum of one hundred CFM (at zero head), properly directed, will provide adequate cooling in the recessed base area. Temperatures of the ceramic/metal seals and the lower envelope areas are the controlling and final limiting factor. Temperature-sensitive paints are available for use in checking temperatures in these areas before equipment design and air-cooling arrangements are finalized.

All base cooling, air and water, *must* be applied before power is applied to the filaments. For standby operation, with no direct anode dissipation, a minimum flow of 5 GPM of anode cooling water is still required to prevent anode overheating, in addition to base cooling.

In all cases, both air-flow and water-flow interlocks should be used to remove all power from the tube in case of a cooling failure. However, cooling normally should be maintained for a brief period after all power is removed to allow for tube cool-down.

ELECTRICAL

FILAMENT OPERATION - Special procedures must be used in the application and removal of filament power. Cooling water flow *must* be on and at the correct level before any voltage is applied. Then a voltage of (approximately) 4 volts should be applied (per section), and held for a minimum of 30 seconds. Voltage can then be gradually increased until the full operating filament voltage level is achieved, but at no time should surge current be allowed to exceed 1600 amperes per section. To remove filament power, the voltage should be reduced gradually to (approximately) 4 volts and held at this level for a minimum of 30 seconds before all voltage is removed.

The peak emission capability at the rated, or nominal, filament voltage is normally many times that required for communication service. A small decrease in filament temperature due to a reduction of filament voltage can increase tube life by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance, such as plate current, power output, or an increase in distortion, while filament voltage is reduced in small steps. At some value of filament voltage there will be a noticeable reduction in plate current or power output, or an increase in distortion. Operation should then be at a filament voltage slightly higher than the point at which performance degradation was

noted. The voltage should be measured at the tube base terminals with a 1% accuracy rms responding meter and periodically checked.

GRID OPERATION - The X-2159 grid is rated at 4000 watts of dissipation. Protective measures should be included in the circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of dc grid current and peak positive grid voltage.

SCREEN OPERATION - Base cooling (air and water) must be on and at the correct level before tube operation is started. The power applied to the screen grid must not exceed 15 kilowatts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of rms screen current and rms screen voltage.

Plate voltage, plate load, or grid bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective circuitry must be provided to remove screen power in case of such a fault condition. Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design and operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished by use of a shunt regulator circuit in the screen voltage supply, or other suitable techniques.

PLATE OPERATION - The maximum dissipation rating of the X-2159 is 1250 kilowatts with water cooling. When used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 800 kilowatts.

FAULT PROTECTION - In addition to the normal plate-overcurrent interlock, screen-current interlock, and coolant (both air and water) interlocks, it is good practice to protect the tube from internal damage caused by an internal plate arc which may occur at high plate voltages. An electronic crowbar, which will discharge power-supply capacitors in a few microseconds after the start of a plate arc, is recommended.

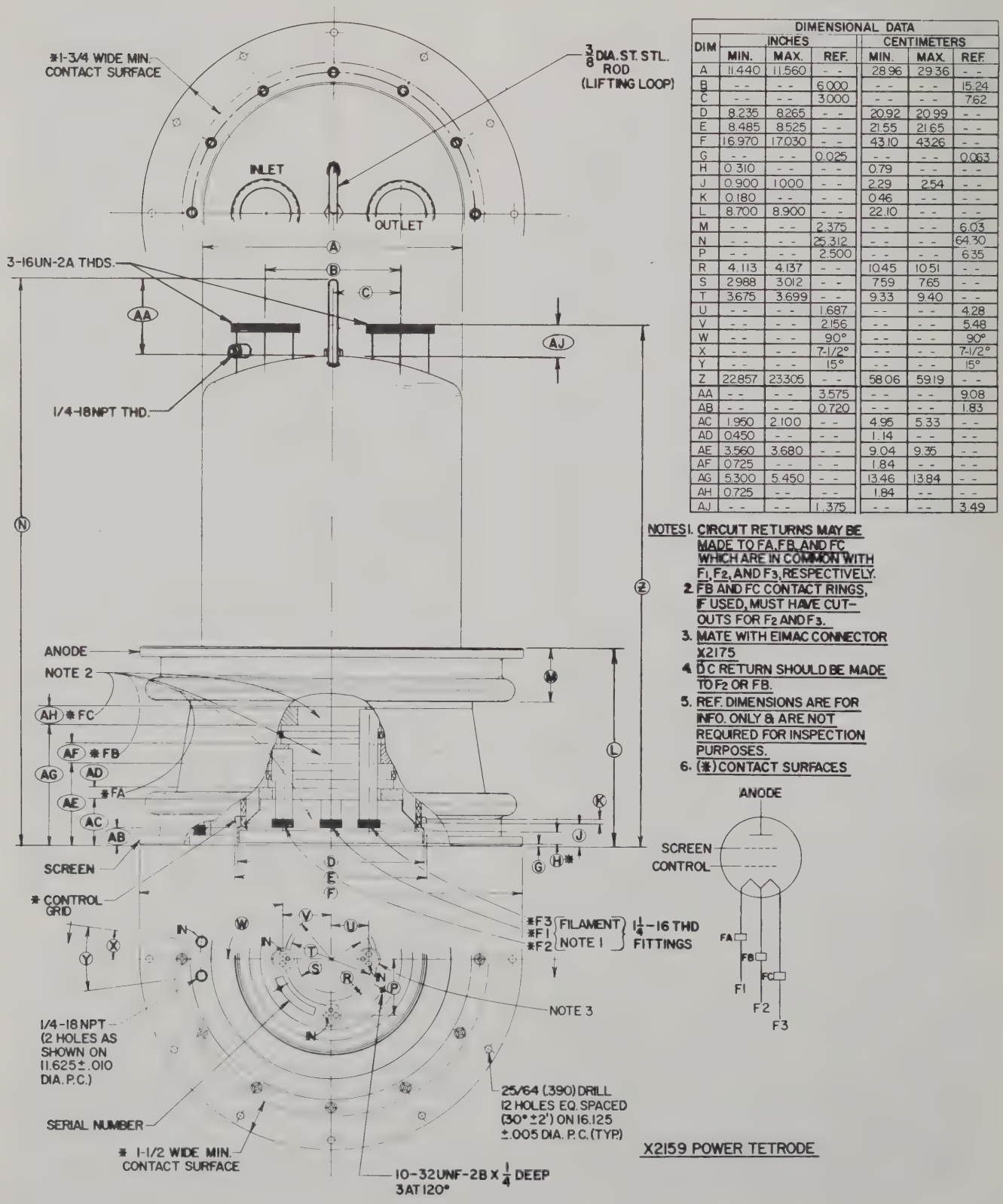
HIGH VOLTAGE - Normal operating voltages used with the X-2159 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The X-2159, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

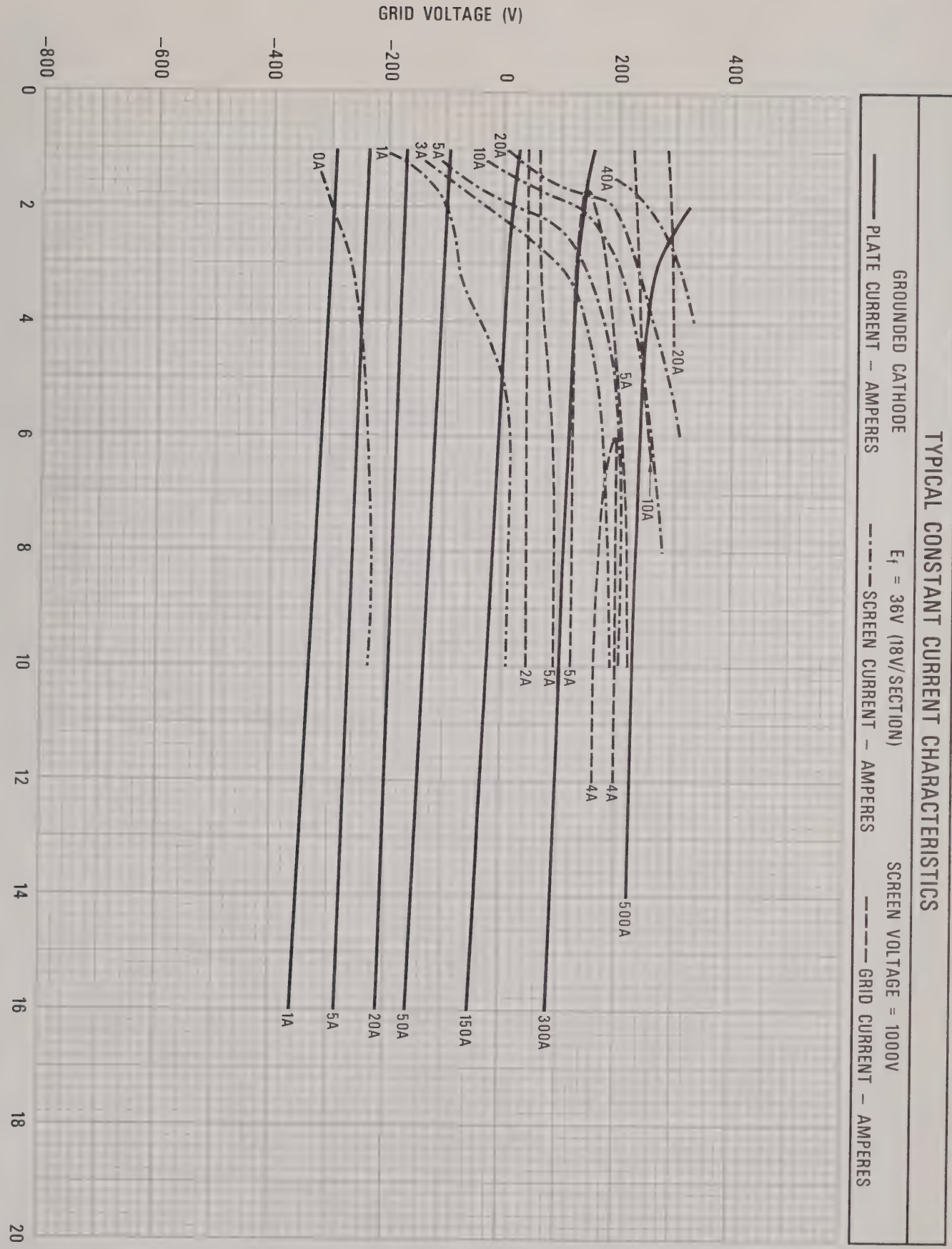
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, Ca. 94070, for information and recommendations.



DIM	INCHES			CENTIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	11.440	11.560	- -	28.96	29.36	- -
B	- -	- -	6.000	- -	- -	15.24
C	- -	- -	3.000	- -	- -	7.62
D	8.235	8.265	- -	20.92	20.99	- -
E	8.485	8.525	- -	21.55	21.65	- -
F	16.970	17.030	- -	43.10	43.26	- -
G	- -	- -	0.025	- -	- -	0.063
H	0.310	- -	- -	0.79	- -	- -
J	0.900	1.000	- -	2.29	2.54	- -
K	0.180	- -	- -	0.46	- -	- -
L	8.700	8.900	- -	22.10	- -	- -
M	- -	- -	2.375	- -	- -	6.03
N	- -	- -	25.312	- -	- -	64.30
P	- -	- -	2.500	- -	- -	6.35
R	4.113	4.137	- -	10.45	10.51	- -
S	2.988	3.012	- -	7.59	7.65	- -
T	3.675	3.699	- -	9.33	9.40	- -
U	- -	- -	1.687	- -	- -	4.28
V	- -	- -	2.156	- -	- -	5.48
W	- -	- -	90°	- -	- -	90°
X	- -	- -	7-1/2°	- -	- -	7-1/2°
Y	- -	- -	15°	- -	- -	15°
Z	22.857	23.305	- -	58.06	59.19	- -
AA	- -	- -	3.575	- -	- -	9.08
AB	- -	- -	0.720	- -	- -	1.83
AC	1.950	2.100	- -	4.95	5.33	- -
AD	0.450	- -	- -	1.14	- -	- -
AE	3.560	3.680	- -	9.04	9.35	- -
AF	0.725	- -	- -	1.84	- -	- -
AG	5.300	5.450	- -	13.46	13.84	- -
AH	0.725	- -	- -	1.84	- -	- -
AJ	- -	- -	1.375	- -	- -	3.49

NOTES:
1. CIRCUIT RETURNS MAY BE MADE TO FA, FB, AND FC WHICH ARE IN COMMON WITH F1, F2, AND F3, RESPECTIVELY.
2. FB AND FC CONTACT RINGS, IF USED, MUST HAVE CUT-OUTS FOR F2 AND F3.
3. MATE WITH EIMAC CONNECTOR X2175
4. DC RETURN SHOULD BE MADE TO F2 OR FB.
5. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
6. (*) CONTACT SURFACES

X2159 POWER TETRODE

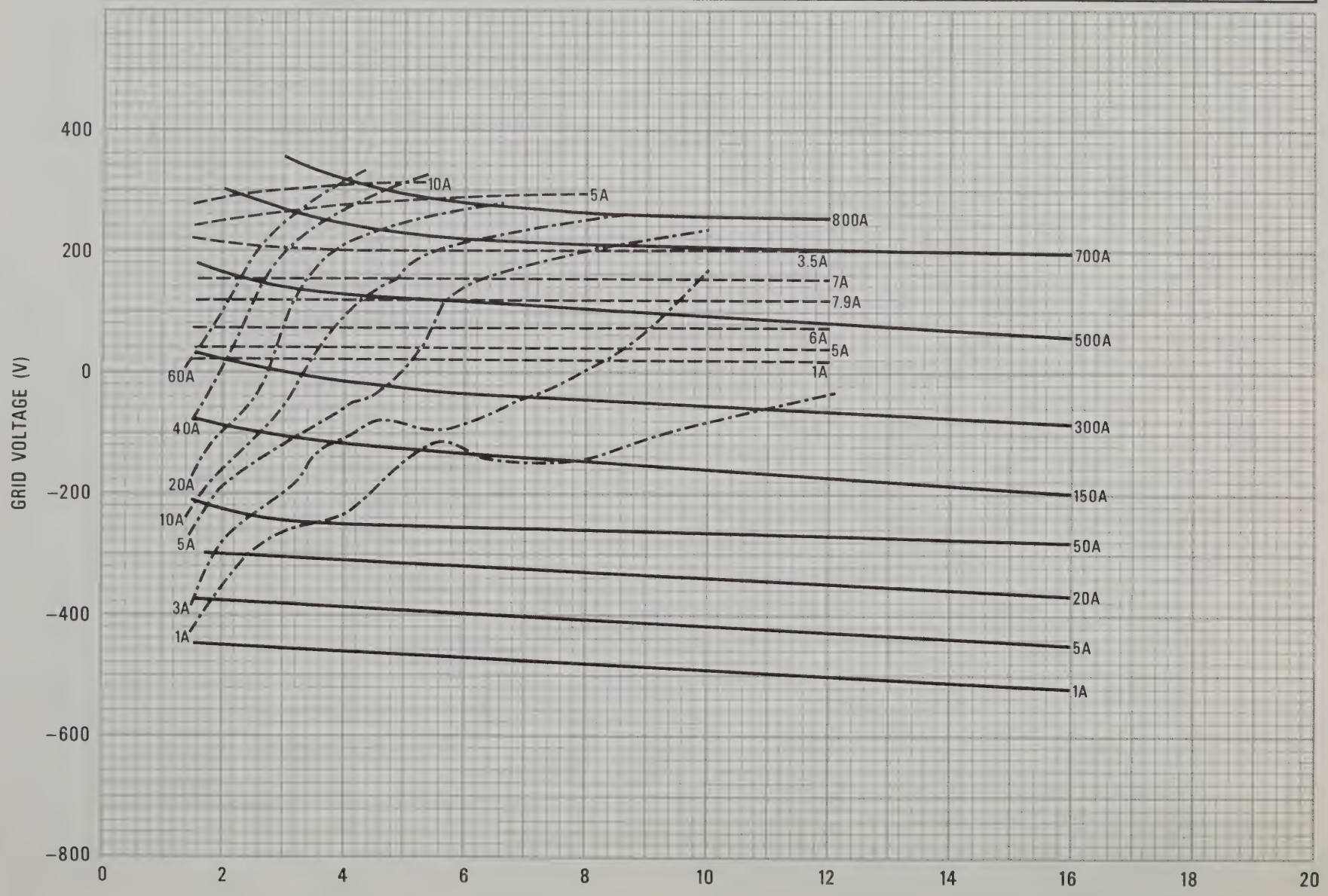

TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
E_f = 36V (18V/SECTION)
SCREEN VOLTAGE = 1000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
400
200
0
−200
−400
−600
−800
0
2
4
6
8
10
12
14
16
18
20
20A
10A
5A
40A
4A
4A
500A
5A
5A
2A
20A
10A
5A
3A
1A
0A
300A
150A
50A
20A
5A
1A

CURVE #4417

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE — E_f = 36V (18V/SECTION) — SCREEN VOLTAGE = 1500V

——— PLATE CURRENT – AMPERES -·-·- SCREEN CURRENT – AMPERES – – – – GRID CURRENT – AMPERES

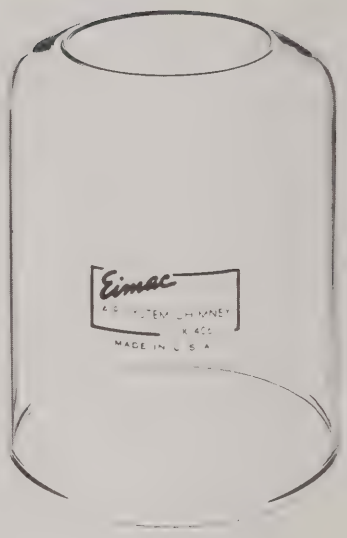


CURVE #4432

TECHNICAL DATA

SK-406
SK-416
SK-426

AIR-SYSTEM CHIMNEYS



The SK-406, SK-416, and SK-426 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat-radiating connector.

MATERIALS

The SK-406, SK-416, and SK-426, Air-System Chimneys are made of sturdy, heat resistant Pyrex glass. The bottom edge is flat for a tight seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

These chimneys are designed for installation above the chassis or plenum that holds the companion Air-System Socket. The four spring clips supplied with the SK-400 and SK-410 sockets act as retaining clips for the chimney. After the socket and spring clips are installed, the chimney is pressed down over the spring clips.

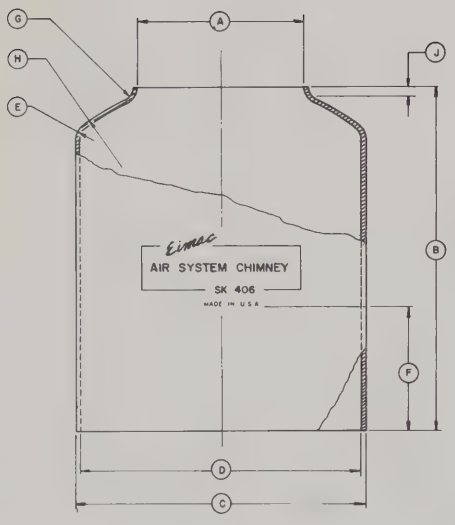
CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-406	3-500Z 4-250A/5D22 4-400A/8438 4-400B/7527 4-400C/6775 4PR400A/8188 175A 6156 5867A 6569 6580	SK-400 OR SK-410
SK-416	3-400Z/8163	
SK-426	4-500A 5-500A	

Net Weight . . . . . SK-406 - 8 ounces
SK-416 - 7 ounces
SK-426 - 8 ounces

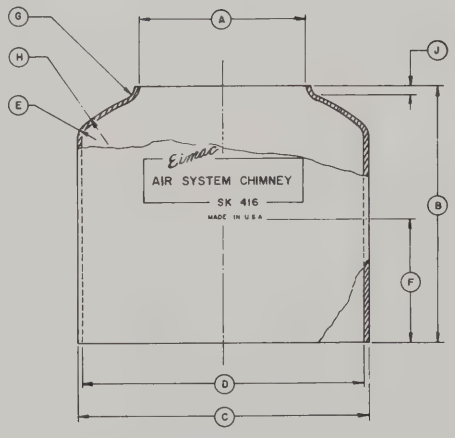
(Revised 12-1-73) 1963, 1965, 1967, 1973 by Varian

Printed in U.S.A.



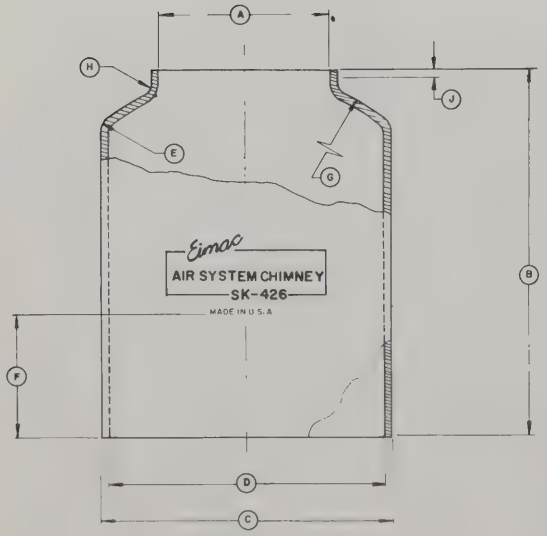
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	2.312	2.438	- -	58.72	61.92	- -
B	4.813	5.000	- -	122.25	127.00	- -
C	- -	4.125	- -	- -	104.77	- -
D	3.718	3.906	- -	94.44	99.23	- -
E	- -	- -	0.250	- -	- -	6.35
F	1.625	1.875	- -	41.27	47.62	- -
G	- -	0.188	- -	- -	4.77	- -
H	- -	- -	3.250	- -	- -	82.55
J	- -	0.188	- -	- -	4.77	- -

SK-406



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	2.312	2.438	- -	58.72	61.92	- -
B	4.000	4.188	- -	101.60	106.37	- -
C	- -	4.125	- -	- -	104.77	- -
D	3.718	3.906	- -	94.44	99.23	- -
E	- -	- -	0.250	- -	- -	6.35
F	1.187	1.312	- -	30.15	33.32	- -
G	- -	0.188	- -	- -	4.77	- -
H	- -	- -	3.250	- -	- -	82.55
J	- -	0.188	- -	- -	4.77	- -

SK-416



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	2.312	2.438	- -	58.72	61.92	- -
B	5.063	5.250	- -	128.60	133.35	- -
C	- -	4.125	- -	- -	104.77	- -
D	3.718	3.906	- -	94.44	99.23	- -
E	- -	- -	0.250	- -	- -	6.35
F	1.625	1.875	- -	41.27	47.62	- -
G	- -	- -	3.250	- -	- -	82.55
H	- -	- -	0.188	- -	- -	4.77
J	- -	- -	0.125	- -	- -	3.17

SK-426

SK-410

AIR-SYSTEM SOCKET

The EIMAC SK-410 is an Air-System Socket recommended for use with the tube types listed below, or other types having the same special five-pin base. Three different glass Air-Chimneys are available from EIMAC for use with the SK-410, depending on the tube type to be used.

The SK-410 is especially recommended for pressurized-chassis installations. Cooling air then cools the base, envelope, and plate-seal areas of the tube, when directed by the proper Air Chimney.

Contact terminals are provided for all five of the tube base connections, with the anode connection made separately at the top of the tube.

The SK-410 and its contact assemblies are humidity and salt-spray resistant.





BASE CONNECTIONS, MATERIALS, AND FINISHES

The socket shell or body is of a molded plastic with excellent insulation characteristics to match the tube types for which this unit was designed. The base contact terminals are made of beryllium-copper and are silver plated. A set of four clips are provided, for locating and holding the recommended Air Chimney. These clips are also made of beryllium-copper and are cadmium plated. Additional clips, of the same type, are required to ground the metal base shell of some tube types; see INSTALLATION notes, below.

NET WEIGHT (Approx.) . . . . . 5.5 oz; 156 gms

INSTALLATION

The SK-410 Air-System Socket can be mounted on a chassis deck, partition, or pressurized compartment. Mounting is accomplished by cutting a proper size hole in the mounting surface, placing the socket below the hole, and fastening it into place with four 6-32 maching screws (not supplied), through the four mounting holes in the "ears" of the socket body. The proper chassis hole size required is dependent on the tube type to be used, and is indicated with the tabulation of tubes and recommended Air-Chimneys shown below. The socket has a 2.4 inch O.D. round neck extending 3/4 inch below the main socket body to provide a means for connecting a standard air duct to the base. Four metal clips are provided for retention and positioning of the Air Chimney. Tube types with a metal base shell will require four additional clips (not supplied) to ground the base shell. The EIMAC Part Number for this clip is 115846.

The following listing shows the EIMAC tube types which may be used with the SK-410, and the recommended Air Chimney. The proper mounting hole size is indicated, and the need for the additional clips for grounding of the tube base shell is shown.

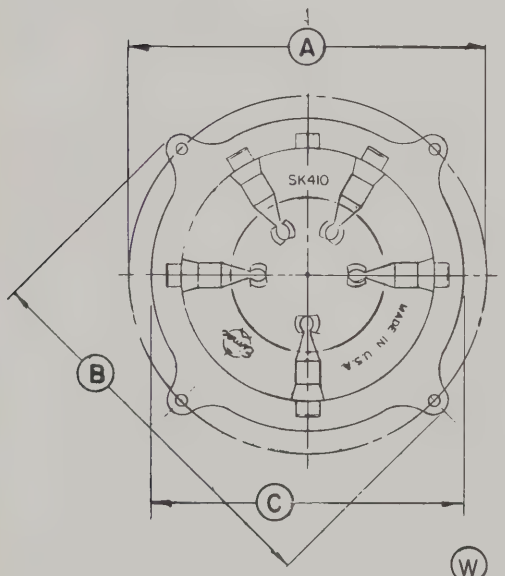
(Revised 12-1-73) 1962, 1973 by Varian Printed in U.S.A.

TUBE TYPE*	AIR CHIMNEY
4-125A / 4D21	None Available
4D21A	None Available
4PR125A / 8247	None Available
4-250A / 5D22	SK-406
4-400A / 8438	SK-406
4-400C / 6775	SK-406
4PR400A / 8188	SK-406
4PR250C / 8248	None Available
4-500A	SK-426
5-500A	SK-426
175A	SK-406
5867A	SK-406
6569	SK-406
6580	SK-406

TUBE TYPE†	AIR CHIMNEY
6155	None Available
3-400Z / 8163	SK-416
3-500Z	SK-406
6156	SK-406
4-400B / 7627	SK-406

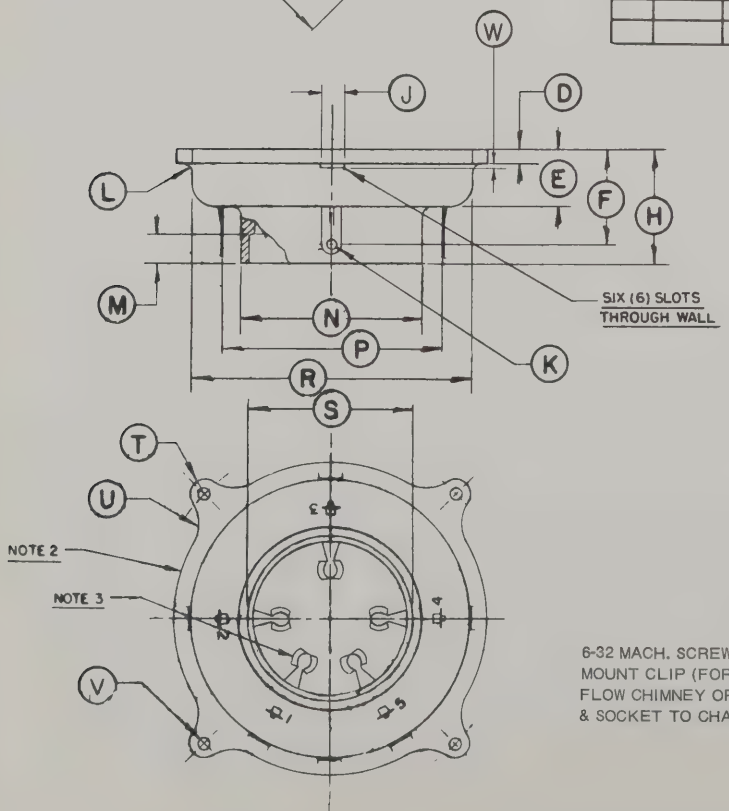
* These types all have a metal base shell. Chassis mounting hole size should be 2-5/8 inch diameter. Four extra base clips should be ordered for shell grounding if Air Chimney is to be used.

† These types have no base shell. Chassis mounting hole size should be 3-5/8 inch diameter. No additional base clips are required.



DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.593	4656	- -	116.66	118.26	- -
B	4.968	5.031	- -	126.19	127.79	- -
C	4.031	4.093	- -	102.39	103.96	- -
D	0.156	0.218	- -	3.96	5.54	- -
E	0.718	0.781	- -	18.24	19.84	- -
F	- -	- -	1.250	- -	31.75	- -
H	1.468	1.531	- -	37.29	38.89	- -
J	0.281	0.343	- -	7.14	8.71	- -
K	0.093	0.156	- -	2.36	3.96	- -
L	0.093R	0.156R	- -	2.36R	3.96R	- -
M	0.343	0.406	- -	8.71	10.31	- -
N	2.343	2.406	- -	59.51	61.11	- -
P	- -	- -	2.890	- -	73.41	- -
R	3.593	3.656	- -	91.27	82.87	- -
S	2.140	2.203	- -	54.36	55.96	- -
T	- -	- -	0.187R	- -	- -	4.75
U	- -	- -	0.500R	- -	- -	12.70
V	0.139	0.152	- -	3.53	3.86	- -
W	0.031	0.093	- -	0.79	2.36	- -

NOTES:
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. SOCKET AND SHELL:
   MAT'L: DIALLYL PHTHALATE.
3. TUBE PIN CONTACT CLIPS.
   MAT'L: BERYLLIUM COPPER
   FINISH: SILVER PLATED.
4. CHIMNEY/GROUNDING CLIP
   PART No. 115846
   MAT'L: BERYLLIUM COPPER, HEAT TREATED
   FINISH: CADMIUM PLATED.
   (4) SUPPLIED WITH SOCKET FOR SECURING CHIMNEY. WHEN ADDITIONAL CHIMNEY/GROUNDING CLIPS ARE REQ'D TO GROUND THE METAL SHELL OF SOME TUBE TYPES THEY MAY BE ORDERED AS PART No. 115846. IT IS RECOMMENDED THAT (4) BE USED WHEN THE METAL SHELL IS TO BE GROUNDED.



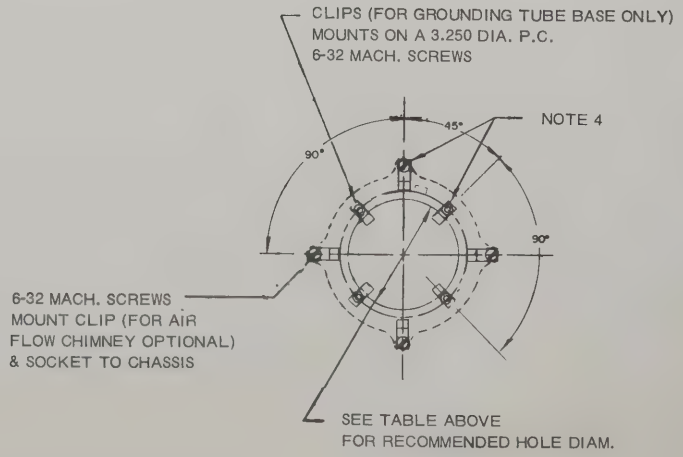


TABLE OF CONTENTS

VOLUME I

GENERAL — Effective Date

Tube Type Numbering System 4-3-58
Distributors 5-15-66
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet .....
Power Frequency Chart for Power Grid ..

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C 1-22-60
2-25A 7-1-52
2-50A 7-1-52
2-150D 12-15-65
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
2X3000F 6-1-63
250R 12-15-65
253 7-1-52
575A & 673 3-16-64
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020(100R) 2-1-52
4PR60B/8252 2-15-62
4PR65A/8187 2-15-63
4PR125A/8247 7-15-62
4PR250C/8248 12-1-63
4PR400A/8188 3-15-66
4PR1000A/8189 12-15-65
6C21 12-15-65
KY21A 1-2-63
RX21A 1-2-63

TRIODES

2C39A 10-25-62
2C39WA 2-7-58
3-400Z/8163 7-15-65
3-1000Z/8164 4-9-64
3C24 11-1-51
3CPN10A5/7815 1-1-63
3CPX100A5/7815R 1-1-63
3CV30,000A3 10-1-63
3CW5000H3 4-1-66
3CW10,000H3 4-1-66
3CW20,000A1 1-1-63
3CW20,000A3 5-1-63
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 11-1-63
3CW30,000H3 2-1-65
3CX100A5/7289 & 3CX100F5/8250 5-1-62
3CX1000A7/8283 3-1-63
3CX2500A3/8161 12-15-64
3CX2500F3 12-15-65

TRIODES (Continued) — Effective Date

3CX2500H3 3-15-66
3CX5000H3 4-1-66
3CX10,000A1/8158 8-14-64
3CX10,000A3/8159 8-15-64
3CX10,000A7/8160 11-1-63
3CX10,000H3 3-15-66
3CX15,000A3 4-11-64
3CX15,000H3 4-1-66
3W5000A1/8240 8-15-64
3W5000A3/8242 6-1-64
3W5000F1/8241 2-18-63
3W5000F3/8243 10-20-61
25T 12-15-65
35T 12-30-57
*35TG 5-1-62
75TH 12-15-65
75TL 1-2-52
100TH 4-1-49
100TL ..... ———
*152TH 11-25-52
*152TL 1-1-44
250TH 5-1-53
250TL 1-1-61
304TH 4-10-53
304TL 12-15-65
450TH 12-15-65
450TL 12-15-65
592/3-200A3 7-1-54
750TL 12-15-65
1000T 12-15-65
1500T 3-18-59
2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7211 9-1-64
7480 10-15-64

TETRODES – PENTODES

4-65A/8165 5-1-62
4-125A 12-15-65
4-250A/5D22 5-1-62
4-400A 9-1-65
4-1000A/8166 7-1-62
4CN15A 1-1-63
4CV8000A 11-8-62
4CV20,000A 11-8-62
4CV35,000A 12-3-62
4CV100,000C/8351 3-15-65
4CW2000A 11-19-63
4CW10,000A 4-15-63
4CW50,000C/8350 10-10-62
4CX125C,F 1-1-63
4CX250B/7203 & 4CX250F/7204 7-15-62
4CX250K/8245 & 4CX250M/8246 1-28-63

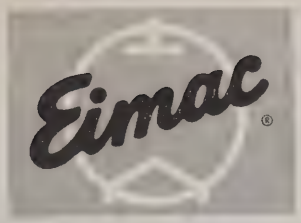
TETRODES–PENTODES (Continued) — Effective Date

4CX250R 6-16-61
4CX300A/8167 12-1-63
4CX300Y 11-1-63
4CX350A/8321 & 4CX350F/8322 6-15-65
4CX600A 5-7-63
4CX1000A/8168 11-4-63
4CX1000K/8352 1-1-64
4CX1500B 1-15-66
4CX3000A/8169 3-1-63
4CX5000A/8170 10-1-64
4CX5000R/8170W 1-1-63
4CX10,000D/8171 1-20-62
4CX15,000A/8281 10-10-62
4CX35,000C/8349 11-1-63
4W300B 6-16-60
4W20,000A/8173 4-15-64
4X150A & 4X150D 6-15-60
4X150G/8172 8-15-63
4X150R/8296 & 4X150S/8297 5-15-62
4X500A 1-1-64
4E27A/5-125B 8-15-52
5-500A 11-15-65
5CX1500A 2-15-65

OTHER PRODUCTS

VS-2, 4, 5, & 6 12-1-63
100 IG Ionization Gauge 6-15-53
Preformed Contact Finger Stock 1-15-62
HR Heat Dissipating Connectors 12-1-65
SK-300A 11-1-64
SK-306, SK-316 5-21-63
SK-400 4-1-56
SK-406, SK-416, SK-426 11-1-65
SK-410 11-15-62
SK-500 3-1-56
SK-506, SK-516 8-15-64
SK-510 5-4-63
SK-600A, SK-610A 11-1-65
SK-606, SK-626, SK-636B 5-24-63
SK-620, SK-620A 1-15-63
SK-630, SK-630A 1-18-63
SK-640 2-15-66
SK-650, SK-655 1-15-66
SK-700, SK-710, SK-606 1-20-58
SK-711A 5-9-63
SK-740 5-9-63
SK-760, SK-770 5-9-63
SK-800B, SK-806 4-9-64
SK-810, SK-806 4-9-64
SK-860, SK-870 5-9-63
SK-890, SK-806 4-9-64
SK-900, SK-906 6-1-60
SK-1300 5-9-63
SK-1306, SK-1406 5-17-63
SK-1400A, SK-1470A 5-9-63

*Not recommended for New Equipment Design.



EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

EIMAC DISTRIBUTORS

Effective June 15, 1966

ALABAMA

Birmingham
Ack Radio Supply Company
3101 4th Avenue South
(205) 322-0588
James W. Clary Company, Inc.
1713 Second Avenue, South
(205) 322-2488
M. G. Electronics & Equip. Co.
3112 6th Avenue, South
(205) 322-0449

Dothan
Hand Supply Company
705 South Oates Street
(205) 792-3148

Gadsden
Southeastern Radio Parts Co.
304 South 4th Street, Box 936
(205) 546-4675

Huntsville
Electronic Wholesalers Inc.
2310 Bob Wallace Avenue
(205) 539-5722
MG Electronics & Equipment Co.
4306 Governors Drive, Box 1243
(205) 837-0305

Mobile
Forbes Electronic Distributor
57 No. Washington Avenue
(205) 432-7661
Specialty Distributing Co. of Alabama, Inc.
1276 Belt Line Highway South
(205) 344-0405

Montgomery
Southeastern Radio Parts Co.
635 East Jefferson Street
Box 1464
(205) 263-6488

Opelika
Southern Electronics Corp.
309 South 10th Street
(205) 745-5298

ALASKA

Anchorage
Yukon Radio Supply
Box 406
272-7964

Juneau
Alaska Radio Supply
307 Seward Street, Box 2538
586-3333

ARIZONA

Phoenix
Midland Specialty Co., Inc.
1930 N. 22nd Street
(602) 258-6476
Radio Parts of Arizona
214 South 11th Avenue
(602) 258-6476

Tucson
Inland Electronic Supply Co. Inc.
715 East Broadway, Box 4010
(602) 792-3070

Yuma
Yuma Electronics Supply
149 Main Street
(602) 782-3866

ARKANSAS

El Dorado
Industrial Electronic Supply, Inc.
413 West Main Street
(501) 862-4901

Fort Smith
Wise Radio & TV Supply, Inc.
1001 Towson Avenue
(501) 783-8925

Little Rock
Carlton-Bates Company
1210 East Sixth Street
(501) 375-5375
David White Radio Supply Co.
1222 Main Street
(501) 376-1391

Texarkana
Lavender Distributing Corp.
520 E. Fourth Street
773-4631

CALIFORNIA

Burlingame
Amrad Electronics
999 Howard Avenue
(415) 342-5757

Chico
Dunlap Electronics
824 Cherry Street
(916) 342-8313

Culver City
JSH Electronics
8549 Higuera Street
(213) 870-4616
837-0177

Fresno
Dunlap Electronics
1740 E. McKinley
(209) 268-6111

Glendale
R. V. Weatherford Co.
6921 San Fernando Road
(213) 849-3451

Lancaster
Manley's Electronic Supply
45003 North Yucca Avenue
(805) 948-1687

Los Angeles
Federated Purchasers, Inc.
11820 West Olympic Blvd.
(213) 272-8771
Henry Radio
11240 West Olympic Boulevard
(213) 477-6701
272-0861
Radio Product Sales Co.
1501 So. Hill Street
(213) 748-1279

Marysville
Dunlap Electronics
1012 Sixth Street 95901
(916) 742-7126

Mountain View
Alcom Electronics
2025 Middlefield Road
(415) 968-7388
Brill Electronics
855 Terra Bella Avenue
(415) 961-1500

Oakland
Brill Electronics
610 East 10th Street
(415) 834-5888
Elmar Electronics, Inc.
140 – 11th Street
(415) 834-3311

Palo Alto
Zack Electronics
654 High Street
(415) 326-5432

Pomona
R. V. Weatherford Co.
1095 E. 3rd Street
(714) 623-1261

Redding
Dunlap Electronics
3082 Bechelli Lane
243-6513

Riverside
Electronic Supply, Inc.
2486 Third Street
(714) 683-8110

Sacramento
Dunlap Electronics
1800 – 18th Street
(916) 444-8070

San Bernardino
Electronic Supply
323 West 7th Street
(714) 884-4791

San Diego
Milo of California, Inc.
(Formerly Electronic Components of San Diego)
2060 India Street
(714) 232-2951
Western Radio & Television Supply Co.
1415 India Street
(714) 239-0361

San Francisco
Fortune Electronics
2280 Palou Avenue
(415) 826-8811
Zack Electronics
1444 Market Street
(415) 621-1444

San Jose
Peninsula Electronic Supply
980 S. First Street
(408) 294-8781
Weatherbie Industrial Electronics, Inc.
1280 N. Fourth Street
(408) 297-9550

Stockton
Dunlap Electronics
27 S. Grant Street
P. O. Box 1970 95201
(209) 446-3373

Temple City
Broadcast Engineering & Equipment Maintenance Co.
9405 Blackley Street
(213) 287-1325

Walnut Creek
Dunlap Electronics
2089 North Broadway, Box 96
(415) 935-8330

COLORADO

Colorado Springs
D & M Electronics
717 North Weber, Box 1777
(303) 633-4668

Denver
Electronic Parts Co.
1277 Broadway
(303) 266-3755
Kierulff Electronics
1200 Stout Street
(303) 825-7033
L. B. Walker Radio Company
300 Bryant Street
(303) 935-2401
Newark-Denver Elect. Supply Corp.
2170 South Grape Street, Box 22045
(303) 757-3351

Grand Junction
Radio & Electronic Supply Co.
640 White Avenue, Box 566
(303) 243-3346

Pueblo
L. B. Walker Radio Company
100 No. Victoria
(303) 542-1924

CONNECTICUT

Hamden
Cramer Electronics Inc.
60 Connolly Parkway
(203) 272-6339

EIMAC DISTRIBUTORS

CONNECTICUT (Continued)

New Haven
Radio Shack, Industrial Div.
92 York Street
(203) 777-7941

Waterbury
Bond Radio Electronics
439 W. Main Street
(203) 753-1184

DISTRICT OF COLUMBIA

Washington
Capitol Radio Wholesalers, Inc.
2120–22 – 14th Street, N. W.
(202) 232-6000
Electronic Wholesalers, Inc.
2345 Sherman Avenue, N. W.
(202) 483-5200

FLORIDA

Ellenton
Slep Electronics Co.
P. O. Box 178, Highway 301
(813) 722-1843

Jacksonville
Southeast Electronics, Inc.
1125 Rosselle Street, Box 2517
(305) 356-3007

Miami
Amateur Radio Center, Inc.
2805 N. E. 2nd Avenue
(305) 374-4101
East Coast Electronics, Inc.
1900 N. W. Miami Court
(305) 371-4635
Electronic Equipment Co. Inc.
2701 N. W. 42nd Avenue
(305) 635-0421
Electronic Wholesalers, Inc.
9390 N. W. 27th Avenue
(305) 696-1620

Orlando
Hammond Electronics Inc.
911 West Central Blvd.
(305) 241-6601
Electronic Wholesalers, Inc.
345 Graham Avenue
(305) 841-1550

Panama City
Central Electronic Supply
318 Luverne Avenue
(305) 785-4821

Tallahassee
Tallahassee Sales
317 West Gaines Street, Box 2585
(305) 224-3368

Tampa
Thurow Electronics Inc.
121 South Water Street
(813) 229-1885

West Palm Beach
Goddard, Inc.
1000 North Dixie Highway
(305) 833-5701

GEORGIA

Atlanta
Jackson Electronic Supply Co.
1135 Chattahoochee Avenue, N. W.
(404) 355-2223
Specialty Distributing Co., Inc.
763 Juniper Street, N. E.
(404) 873-2521

HAWAII

Honolulu
Honolulu Electronics
819 Keeamuoku Street
999564
Industrial Electronics Inc.
646 Queen St.
506-095
Pacific Electronics
1336 Dillingham Blvd.
817-118, 816-865
Precision Radio Ltd.
1160 South King Street
575291
Radio Television Corp. Ltd.
432 Keawe Street
502901

IDAHO

Twin Falls
United Electronics Wholesale
217 - 2nd Avenue North
(208) 733-7324

ILLINOIS

Chicago
Allied Radio Corp.
100 North Western Avenue
(312) 421-6800
Newark Electronics Corp.
223 West Madison Street
(312) 782-2944

Franklin Park
Richardson Electronics, Ltd.
9001 Exchange Place
(312) 678-2923

Peoria
Klaus Radio & Electric Co.
403 East Lake Street
(309) 688-3401

INDIANA

Evansville
Ohio Valley Sound
20 E. Sycamore
(812) 425-6173

Indianapolis
Graham Electronics Supply Co.
122 South Senate
(317) 634-8486

IOWA

Cedar Rapids
Deeco, Inc.
618 First Street, N. W.
(319) 365-7551

Council Bluffs
World Radio Laboratories
3415 West Broadway
(712) 342-4720

Davenport
TCR Distributors
1205 East River Drive, Box 29
(319) 323-8051

Des Moines
Radio Trade Supply Company
1224 Grand Avenue
(515) 288-7237

Mason City
Waters Electronic Supply
516 S. Delaware
(515) 423-5889

KANSAS

Wichita
Radio Supply Company, Inc.
115 Laura
(316) 267-5214

KENTUCKY

Louisville
P. I. Burks & Company, Inc.
659 South Ninth Street
(502) 583-2871

Owensboro
Ohio Valley Sound
600 W. Third Street
(502) 683-6727

Lexington
Radio Electronic Equipment Co.
480 Skain Avenue
(606) 254-5550

LOUISIANA

Alexandria
Central Radio Supply
601 N. Third Street
(318) 443-4517

Lafayette
Ralph's of Lafayette, Inc.
3004 Cameron, Box R
(318) 234-4507

Lake Charles
Wholesale Radio Equipment, Inc.
1722 Common Street, Box NN
(318) 439-9017

New Orleans
Radio Parts, Inc.
1112 Magazine Street
(504) 522-0217
Southern Radio Supply Company
1909 Tulane Avenue
(504) 524-2345

Shreveport
Industrial Electronic Supply, Inc.
2422 Southern Avenue
(318) 422-9459
Interstate Electric Company
1419 Culpepper Street
(318) 423-6131
Koelemay Sales Company
2530 Linwood Avenue
423-4256

MARYLAND

Baltimore
Kann-Ellert Electronics, Inc.
2050 Rockrose Avenue
(301) 889-4242
Valley Electronic, Inc.
8809 Satyr Hill Road
(301) 668-4900

MASSACHUSETTS

Boston
DeMambro Electronics
1095 Commonwealth Ave.
(617) 783-1200
Radio Shack Corp.
730 Commonwealth Avenue
(617) 734-6811

Newton
Cramer Electronics, Inc.
320 Needham Street
(617) 969-7700

Springfield
Soundco Electronic Supply Co., Inc.
147 Dwight Street
(413) 739-3947

Reading
Graham Radio, Inc.
505 Main Street
(617) 944-4000

MICHIGAN

Detroit
Newark-Detroit Electronics, Inc.
20700 Hubbell
(313) 548-0250
Radio Specialty Company
12775 Lyndon Avenue
(313) 272-4212

Flint
Shand Electronics, Inc.
2401 South Dort Highway
(313) 238-0477

Kalamazoo
Electronic Supply Corp.
429 E. Kalamazoo Ave., Box 831
(616) 381-4623

MINNESOTA

Duluth
Northwest Radio
123 East First Street
(218) 727-1565

Minneapolis
Electronic Center
107 Third Avenue North
(612) 338-8678
Lew Bonn Company
1211 La Salle Avenue
(612) 339-9461

St. Paul
Stark Electronic Supply
154 University Avenue
(612) 222-4781

MISSISSIPPI

Hattiesburg
Swan Electronics, Inc.
506 Bouie Street, Box 766
(601) 584-5494

Jackson
Swan Electronics, Inc.
342 N. Gallatin Street, Box 3289
(601) 352-5516
Mississippi Valley Elect. Supplies, Inc.
166-1/2 E. Porter
(601) 948-5454

MISSOURI

Butler
Henry Radio Company
211 North Main Street
(816) 679-3127
Joplin
Four State Radio Supply Company
402 Wall Street
(417) 624-0368
Kansas City
Burstein-Applebee Company
1012–14 McGee Street
(816) 221-1155
Walters Radio Supply Company
3635 Main Street
(816) 531-7015
St. Louis
Interstate Industrial Elect. Inc.
2218 South Jefferson Avenue
(314) 773-4990
Van Sickle Radio Electronics Inc.
1113 Pine Street
(314) 241-2700
Walter Ashe Radio Company
1125 Pine Street
(314) 241-1125
University City
Olive Industrial Electronics, Inc.
6662 Olive Street Road
(314) 863-4051

MONTANA

Billings
Electronic Supply Company
250 - 11th Street West
(406) 252-2197
Interstate Distributing Company
2112 – 4th Avenue N.
P. O. Box 2523
(406) 245-5141

NEBRASKA

Lincoln
Scott Electronic Supply Corp.
2201–2207 "O" Street
(402) 432-6558
Omaha
Radio Equipment Company
625 North 18th Street
(402) 341-7709
Scottsbluff
Joachim Radio Supply Co.
1913 Broadway, Box 67
(308) 632-2181

NEVADA

Las Vegas
Electronic Supply Co.
1112 South 2nd Street
(702) 384-5666
Reno
Dunlap Electronics
555 Eureka
P.O. Box 2471
(720) 329-1308
Electronic Distributing Co. EDCO
720 Tahoe Street, Box 2918
(720) 323-2766

NEW HAMPSHIRE

Concord
Evans Radio, Inc.
P. O. Box 312
(603) 225-3358

NEW JERSEY

Camden
General Radio Supply Co., Inc.
600 Penn Street
(609) 964-8560
Springfield
Federated Purchasers, Inc.
155 U. S. Route 22
(201) 376-8900

NEW MEXICO

Alamagordo
Kierulff Electronics Co., Inc.
209 Pennsylvania Avenue
(505) 437-0370
Albuquerque
Electronic Parts Co., Inc.
222 Truman Street, N. E.
(505) 265-8401
Midland Specialty Company
1712 Lomas Blvd., N. E.
(505) 247-2486
Los Alamos
Valley Engineering, Inc.
601 Cedar
2-3310
Roswell
R & R Electronic Supply Co.
605 East 2nd Street
(505) 622-0670

NEW YORK

Albany
Ft. Orange Radio Dist. Co., Inc.
904–916 Broadway
(518) 436-8411
Buffalo
Radio Equipment Corp.
147 Genesee Street
(716) 856-1415
Farmingdale, L.I.
Arrow Electronics, Inc.
900 Broad Hollow Rd. (Rt. 110)
(516) 694-6800
Lynbrook, L.I.
Peerless Radio Dist., Inc.
19 Wilbur Street
(516) 593-2121
Jamaica, L.I.
Mars Aircraft Radio Supply Corp.
Hangar No. 1
J. F. Kennedy Int'l. Airport
(212) 656-5656
New York City
Barry Electronics Corp.
512 Broadway
(212) 925-7000
Calvert Electronics, Inc.
220 East 23rd Street
(212) 679-1340
Electronic Tube Sales
161 Washington Street
(212) 227-4141
Harrison Radio Corp.
225 Greenwich Street
(212) 227-7777
Harvey Radio Corp., Inc.
103 West 43rd Street
(212) 582-1500
Metropolitan Supply Co.
Division Metropolitan Overseas Supply Corporation
443 Park Avenue South
(212) 686-2834
Midway Radio & Television Corp.
58 W. 45th Street
(212) 687-5053
Milgray Electronics, Inc.
160 Varick Street
(212) 989-1600
Milo Electronics Corp.
530 Canal Street
(212) 233-2980
State Labs., Inc.
215 Park Avenue, South
(212) 677-8400
Terminal-Hudson Electronics, Inc.
236 W. 17th Street
(212) 243-5200
Visual Electronics Corp.
356 West 40th Street
(212) 736-5840
Rochester
Rochester Radio Supply Inc.
140 West Main Street
(716) 562-9900

NORTH CAROLINA

Asheville
Freck Radio & Supply, Inc.
38 Biltmore Avenue
(704) 254-9551
Fayetteville
Eastern Radio Supply Inc.
952 Bragg Boulevard
High Point
Womack Electronics
130 Lindsay Street
(919) 882-4177
Raleigh
Southeastern Radio Supply Co. Inc.
414 Hillsboro Street
(919) 828-2311
Winston-Salem
Electronic Wholesalers, Inc.
938 Burke Street
(919) 725-8711

NORTH DAKOTA

Fargo
Bristol Distributing Co.
1345 Main Street, Box 1818
(701) 232-7394
Minot
John Iverson Company
216 South Broadway
(701) 838-5466

OHIO

Akron
The Sun Radio Company
110 East Market Street
(216) 434-2171
Cincinnati
Hughes-Peters, Inc.
1128 Sycamore Street
(513) 381-7625
Cleveland
Pioneer-Standard Electronics, Inc.
5403 Prospect Avenue
(216) 432-0010
Radio & Electronic Parts Corp.
3235 Prospect Avenue
(216) 881-6060
Columbus
Hughes-Peters, Inc.
481 East 11th Avenue
(614) 294-5351
Dayton
Pioneer-Standard Electronic Supply Co.
314 Leo Street
(513) 224-0871
Stotts-Friedman Company
108–112 N. Jefferson Street
(513) 224-1111
Toledo
Warren Radio Company
1002 Adams Street
(419) 248-3364
Youngstown
Ross Radio Co.
325 West Federal Street
(216) 746-8881

OKLAHOMA

Oklahoma City
Radio Supply, Inc.
724 North Hudson Street
(405) 232-6128
Tulsa
Radio, Inc.
1000 South Main Street
(918) 587-9124
S & S Radio Supply
537 South Kenosha
(918) 582-8242

OREGON

Medford
Verl G. Walker Company
205 West Jackson Street, Box 1586
(503) 773-7557

EIMAC DISTRIBUTORS

OREGON (Continued)

Portland
Lou Johnson Co., Inc.
2720 N. W. 29th
(503) 222-9551
United Radio Supply Inc.
22 N. W. 9th Avenue
(503) 226-6334

PENNSYLVANIA

Altoona
Allegheny Electronics, Inc.
1720 Union Avenue
(814) 944-0828

Philadelphia
Almo Industrial Electronics, Inc.
412 North 6th Street
(215) 922-5918
JOA Cartridge Service
P. O. Box 3087, Wadsworth Station
(215) 886-7993
Philadelphia Electronics, Inc.
1225–27–29 Vine Street
(215) 568-7444

Pittsburgh
Cameradio Company
1121 Penn Avenue
(412) 391-4000
Radio Parts Co., Inc.
6401 Penn Avenue
(412) 361-6400

Reading
George D. Barbey Company
333 North 4th Street
(215) 376-6116

Scranton
Fred P. Pursell
1221-37 N. Washington Avenue
(717) 346-2011

State College
Alvo Electronics Distributors, Inc.
103 South Pugh Street
(814) 238-6277

SOUTH CAROLINA

Charleston
Wholesale Radio Supply Company
515 East Bay Street
(803) 722-2634

Columbia
Dixie Radio Supply Company
1900 Barnwell Street
(803) 253-5333

Greenville
Carolina Radio Supply Co. Inc.
221 West Washington Street, Box 2670
(803) 239-5125

SOUTH DAKOTA

Sioux Falls
Warren Radio Supply
196 East 6th Street
(605) 336-1830

TENNESSEE

Chattanooga
Specialty Distributing Co.
1313 Central Avenue
(615) 267-9531

Jackson
L. K. Rush Co., Inc.
425-31 North Royal Street, Box 1418
(901) 422-6533/4

Kingsport
Radio Electric Supply Co., Inc.
961 East Sullivan Street
(615) 247-8111

Knoxville
Chemcity Radio & Electric Co.
2211 Dutch Valley Road
(615) 687-3530
McClung Appliances
310 Georgia Street, N. E.
Box 3266
(615) 524-1811

Memphis
Bluff City Distributing Co.
234 East Street, Box 418
(901) 276-4501
Lavender Electronics, Inc.
190 South Cooper
(901) 276-2757
W & W Distributing Co.
644-46 Madison Avenue
(901) 527-4627

Nashville
Electra Distributing Company
1914 West End Avenue
(615) 255-8444

Tullahoma
Randolph & Holt, Inc.
304 South Atlantic St.
(615) 455-4531

TEXAS

Amarillo
West Texas Electronics Co.
1601 W. Third Street
(806) 376-6251

Beaumont
Sterling Electronics Inc.
1160 Laurel
(713) 833-7503

Corpus Christi
Elec. Equipment & Engineering Co.
805 South Staples Street, Box 3672
(512) 883-9271
Wicks Radio Equipment Co.
513 South Staples Street
(512) 884-8285

Dallas
Adleta Electronics Company
1907 McKinney Avenue
(214) 742-8257
Com-Supply Incorporated
900 Dragon Street
(214) 747-7508
T. I. Supply Company
6000 Denton Drive
(214) 357-6121
Wholesale Electronic Supply
2809 Ross Avenue
(214) 824-3001

El Paso
McNicol, Inc.
3012 East Yandell Street
(915) 533-2936
Midland Specialty Company
2235 Wyoming Street
(915) 533-9555

Houston
Busacker Electronic Equip.
1216 West Clay Street
(713) 526-4661

Laredo
Broadcast Electronics Corp.
1314 Iturbide Street
(512) 723-9422

Lubbock
Nunn Electric Supply Corp.
1817 4th Street, Box 5727
(806) 765-5741

San Antonio
Sterling Electronics, Inc.
3903 San Pedro
(512) 735-9173

UTAH

Ogden
Ballard Supply Corporation
3109 Washington Boulevard
(801) 394-5544

Salt Lake City
Ballard Supply Corp.
44 East 6th South Street
(801) 364-6541
Broadcast Services, Inc.
145 Social Hall Avenue
(801) 355-4641
Electronic Sales Corp. (ELSCO)
2275 S. W. Temple
(801) 466-8631
S. R. Ross, Inc.
1212 South State, Box 1055
(801) 328-0591
Standard Supply Company
225 E. 6th South Street, Box 1047
(801) 355-2971

VIRGINIA

Charlottesville
Virginia Radio Supply Co., Inc.
Box 1189
715 Henry Avenue
(703) 296-4184

Norfolk
Priest Electronics, Inc.
6431 Tidewater Drive
(703) 885-2021

Richmond
Meridian Electronics Inc.
1001 West Broad Street
(703) 353-6648

Roanoke
H. C. Baker Sales Company, Inc.
17–19 Franklyn Road, S. W.
(703) 344-9209

WASHINGTON

Bellingham
Advanced Electronics
804 Dupont & D Streets
(206) 733-0280

Seattle
Robert E. Priebe Company
2228 Second Avenue
(206) 682-4354
Seattle Radio Supply Co., Inc.
2117 Second Avenue
(206) 624-2341
Westlake Electronic Supply Co., Inc.
415 Westlake Ave., North
(206) 622-6600

Spokane
HCJ Electronics
6904 Sprague East
(509) 924-2343
Northwest Electronics, Inc.
730 East First Avenue
Term. Box 3047
(509) 534-2644

WEST VIRGINIA

Charleston
Mountain Electronics Company
708 Bigley Avenue
(304) 344-3411

WISCONSIN

Eau Claire
Indianhead Electronic Supply
515 Wisconsin Street 54701
834-3606

Madison
Satterfield Electronics, Inc.
1900 South Park Street, Box 1438
(608) 257-4801

Milwaukee
Radio Parts Company, Inc.
1314 North 7th Street
(414) 276-4160

WYOMING

Casper
Fleming Supply Inc.
328 East 'A' Street
(307) 236-6056
Hathaway Electronic Supply
333 North Wolcott, Box 930
(307) 234-1821

Cheyenne
Houge Radio & Supply Company
4012 Central Avenue
(307) 632-6474

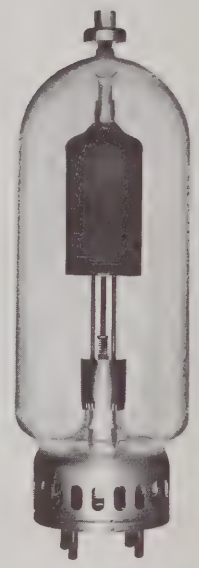
EIMAC

A Division of Varian Associates

2-450A

HIGH-VACUUM RECTIFIER

The Eimac 2-450A is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications where high peak-inverse voltages, extreme temperatures, high operating frequency, or the production of high-frequency transients would prevent the use of mercury-vapor or gas-filled rectifier tubes.



CHARACTERISTICS

ELECTRICAL

		Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten					
	Voltage		7.5		volts
	Current	25.0		28.0	amperes

MECHANICAL

Base	4-pin, metal shell
Socket	E. F. Johnson Co. 124-214 or equivalent
Operating Position	vertical, base down or up
Recommended Plate Connector	Eimac HR-8
Maximum Operating Temperatures:	
Plate Seal	225°C
Envelope	250°C
Net Weight	2.4 pounds
Shipping Weight (approximate)	9 pounds

COOLING

The temperature of the plate seal and envelope must not be allowed to exceed 225°C and 250°C respectively. When several tubes are being operated in the same compartment and at or near maximum rated plate dissipation, forced-air cooling is required. In any event, it should be remembered that the listed temperatures are maximums and that lower operating temperatures will result in longer life and improved reliability. The use of a temperature-sensitive paint, sparingly applied in the referenced areas, is recommended to determine the effectiveness of the cooling employed in any given installation.

MAXIMUM RATINGS

Peak Inverse Plate Voltage	30,000 MAX. VOLTS
Plate Dissipation	450 MAX. WATTS
D-C Plate Current	1 MAX. AMPERE
Peak Plate Current	8 MAX. AMPERES

MAXIMUM POWER-SUPPLY CAPABILITIES*

Circuit	Maximum A-C Input Voltage (volts rms)	Approx. D-C Output Voltage (volts)	Maximum D-C Output Current (amps)
Single-Phase, Full-Wave (2 tubes)	21,200 total	9,300	2.0
Single-Phase, Bridge (4 tubes)	21,200 total	18,600	2.0
Three-Phase, Full-Wave (6 tubes)	12,250 per leg	28,000	3.0

*Choke-input filter with L equal to or greater than twice "critical"; zero circuit loss assumed; tube drop considered.

CHOKE-INPUT FILTER

The maximum d-c current rating of the 2-450A is 1.0 amperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance. This value may be calculated from the appropiate formula below:

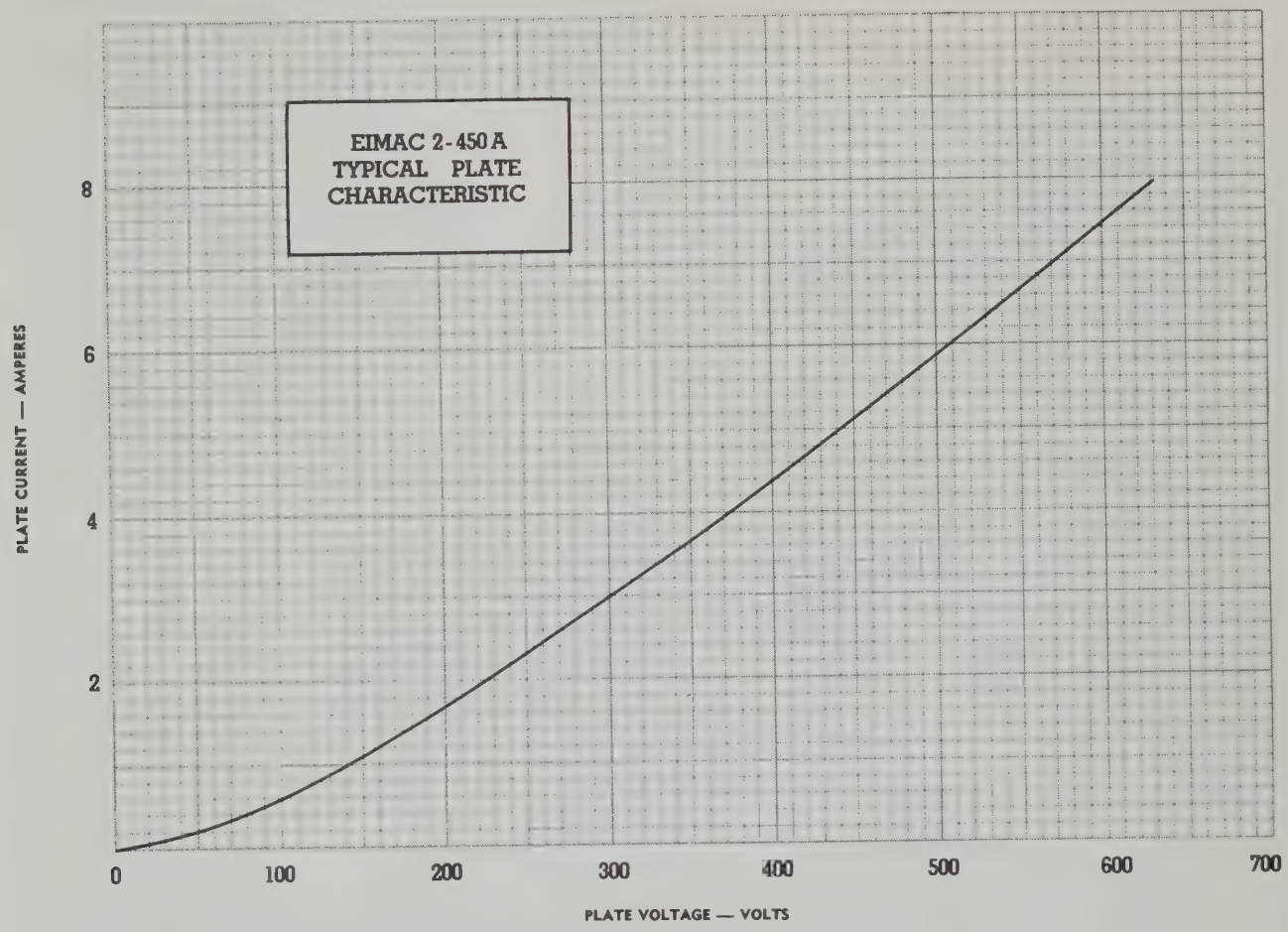
$$L_o = \frac{R_{eff}}{18.8f} \left\{ \begin{array}{l} \text{for full-wave} \\ \text{single wave} \\ \text{power supplies} \end{array} \right. \qquad L_o = \frac{R_{eff}}{75f} \left\{ \begin{array}{l} \text{for half-wave} \\ \text{three-phase} \\ \text{power supplies} \end{array} \right. \qquad L_o = \frac{R_{eff}}{660f} \left\{ \begin{array}{l} \text{for full-wave} \\ \text{three-phase} \\ \text{power supplies} \end{array} \right.$$

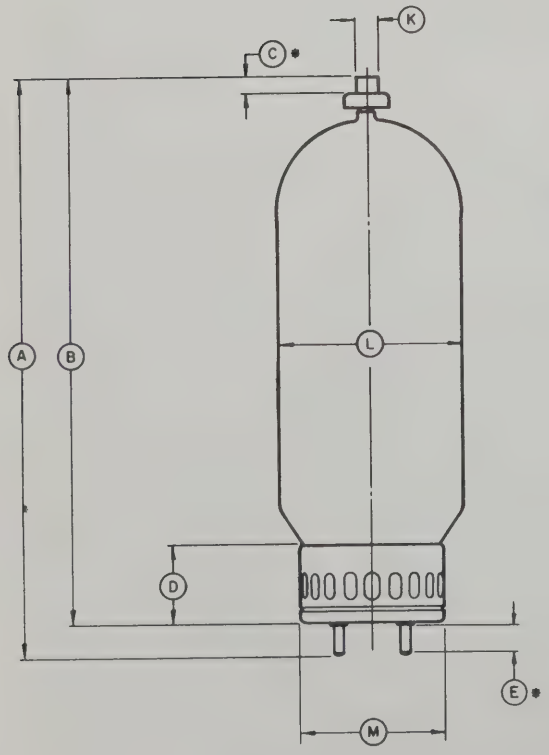
where: L_o = "critical" value of input inductance (henries) f = supply-line frequency (cycles per second)

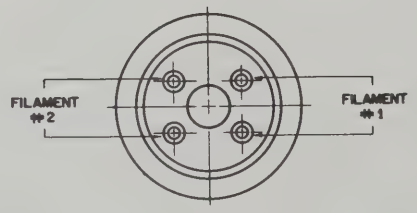
$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}$$

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

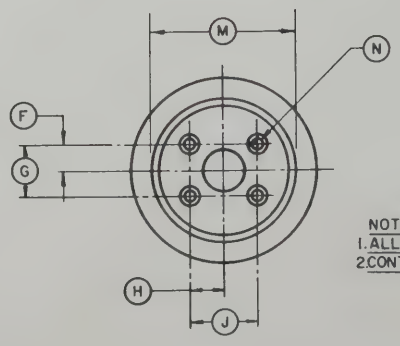
(Revised 3-1-66) Copyright 1959, 1966 by Varian Associates







DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		13 1/8	14 1/8
B		12 1/4	13 1/4
C		.445	.465
D	1 3/4		
E		.662	.712
F		.610	.640
G		1.235	1.265
H		.829	.859
J		1.672	1.702
K		.558 DIA.	.568 DIA.
L			4 5/8 DIA.
M			3 5/8 DIA.
N		.247 DIA.	.251 DIA.



NOTES:
1. ALL DIMENSIONS IN INCHES.
2. CONTACT SURFACE (*).

Printed in U.S.A. 82587

EIMAC

A Division of Varian Associates

3CW5000H3

INDUSTRIAL
MEDIUM-MU
WATER-COOLED
POWER TRIODE

The EIMAC 3CW5000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 5 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 12.5 kilowatts is permissible up to 75 megahertz. Plentiful reserve emission is available from its 375 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		Volts
Current	48		53	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Grid-Filament	29.2		40.2	$\mu\mu$f
Plate-Filament	0.60		1.20	$\mu\mu$f
Grid-Plate	17.8		24.2	$\mu\mu$f
Frequency for Maximum Ratings			75	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	7.5 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Effective 4-1-66) © 1966 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000 volts
DC PLATE CURRENT	2.5 amps
DC GRID VOLTAGE	—1000 volts
DC GRID CURRENT	0.4 amp
PLATE INPUT POWER	12.5 kW
PLATE DISSIPATION (NOMINAL)	5 kW

TYPICAL OPERATION*

DC Plate Voltage	4000	6000 volts
DC Plate Current	2.5	2.08 amps
DC Grid Voltage	—300	—500 volts
DC Grid Current	.245	.180 amps
Peak Positive Grid Voltage	280	265 volts
Driving Power	142	136 watts
Plate Input Power	10,000	12,500 kW
Plate Dissipation	2,500	2,500 kW
Plate Output Power	7,500	10,000 kW
Approximate Load Impedance	910	1,625 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW5000H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.4 ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Overcurrent protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.275 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 150 watts.

Plate Operation

Maximum plate voltage rating of 6000 volts and maximum plate current of 2.5 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 12.5 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW5000H3 is usable to 110 MHz. At this frequency, plate voltage must be reduced to 4000 volts in Class C service.

MECHANICAL

Mounting

The 3CW5000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 15°C temperature rise inlet to outlet water.

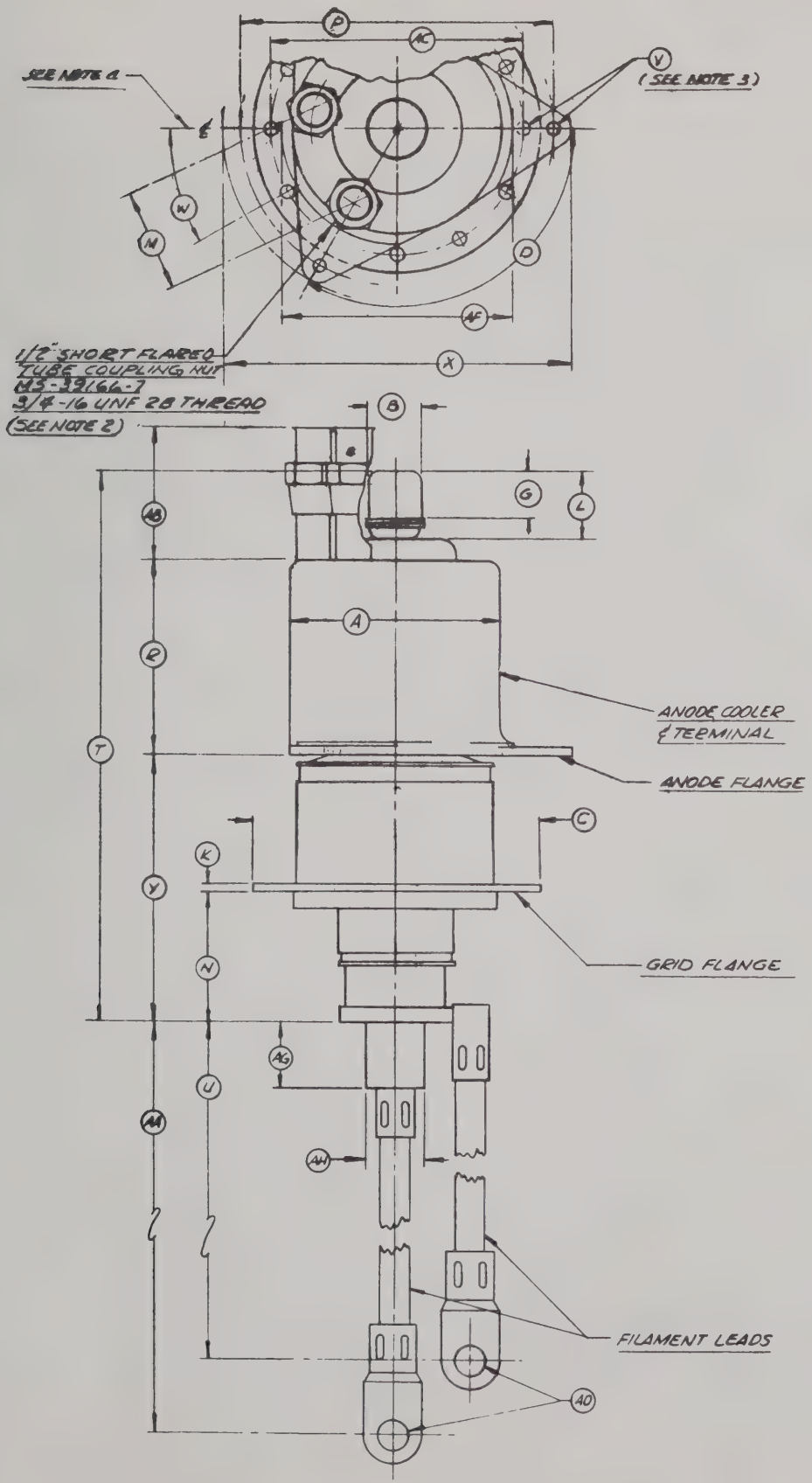
MINIMUM WATER-COOLING REQUIREMENT

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
3.0	0.65	0.27
5.0	1.10	0.70
7.0	1.75	1.75

Additional stem cooling air must be provided. 13 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by a 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

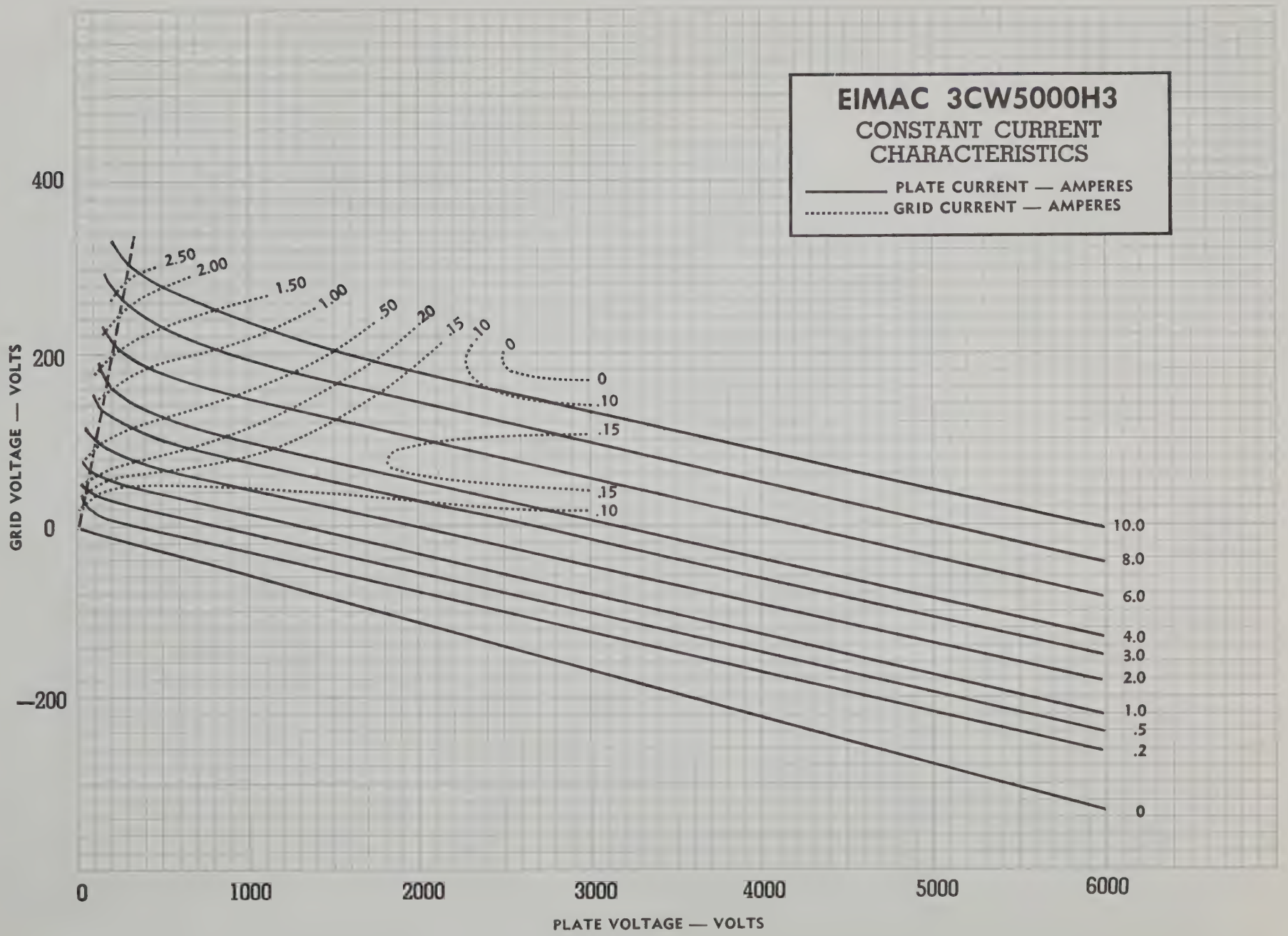
Special Application

If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	3.300	3.400	
B	.780	.843	
C	4.230	4.250	
D	118°	122°	
G	.687	.812	
K			.125
L	1.000	1.125	
M			1.500
② N	1.703	1.953	
P	4.615	4.635	
R	2.625	2.875	
T	8.000	9.000	
U	7.937	8.437	
V			.250
W	29°	31°	
X	5.330	5.420	
Y	3.875	4.250	
AA	8.937	9.437	
AB			2.000
AC	3.855	3.885	
AD			.390
AF			3.625
AG	.812	.937	
AH	.859	.890	

NOTE:
1. REF. DIM. ARE FOR INFO ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.
2. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
3. 3 HOLES IN ANODE FLANGE, 12 HOLES IN GRID FLANGE.
4. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW5000H3
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
400
200
0
—200
GRID VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

EIMAC
A Division of Varian Associates

3CW10,000H3

INDUSTRIAL MEDIUM-MU

WATER-COOLED POWER TRIODE

The EIMAC 3CW10,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 10 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 30 kilowatts is permissable up to 90 Megahertz. Plentiful reserve emission is available from its 560 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		Volts
Current	73		78	Amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Input			53	$\mu\mu$f
Output			1.5	$\mu\mu$f
Grid-Plate			25	$\mu\mu$f
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperature	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	10 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Effective 4-1-66) © 1966 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR
Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	30 kW
DC PLATE CURRENT	10 kW
DC GRID VOLTAGE	—1000 Volts
DC GRID CURRENT	0.5 Amp
PLATE INPUT POWER	25 kW
PLATE DISSIPATION	5 kW

TYPICAL OPERATION*

DC Plate Voltage	7000	9000	Volts
DC Plate Current	2.88	2.9	Amps
DC Grid Voltage	—700	—900	Volts
DC Grid Current	0.180	0.185	Amps
Peak Positive Grid Voltage	250	250	Volts
Driving Power	170	215	Watts
Plate Input Power	20.15	26.1	kW
Plate Dissipation	5.15	5.5	kW
Plate Output Power	15	20.6	kW
Approximate Load Impedance	1120	1470	Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

For the 3CW10,000H3 the rated filament voltage is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.5 ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.25 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 150 watts.

Plate Operation

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CW10,000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 15°C temperature rise of water from inlet to outlet.

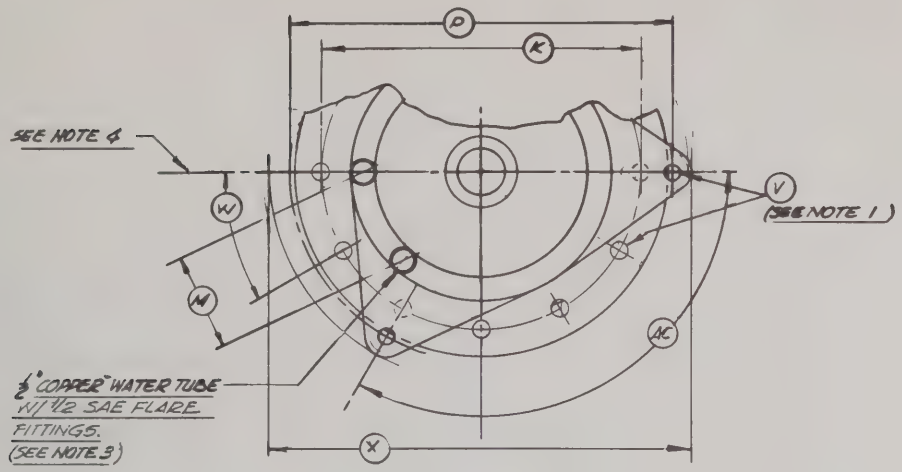
MINIMUM WATER-COOLING REQUIREMENT

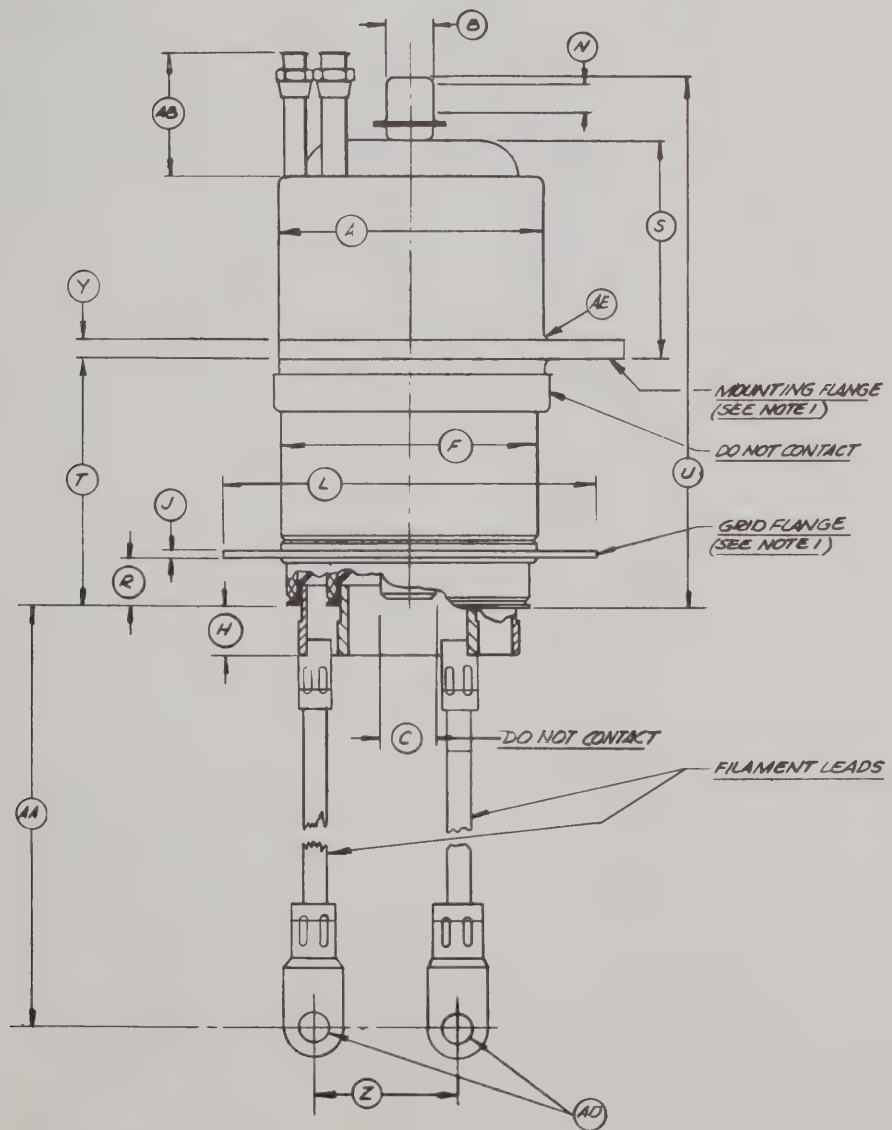
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
8	3.2	5.5
10	4.4	8.1
12	5.8	13.4

Additional stem cooling air must be provided. 8 CFM of air directed against the center filament contact ring ½ inch below the outer filament contact ring by a 1½ inch I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

Special Applications

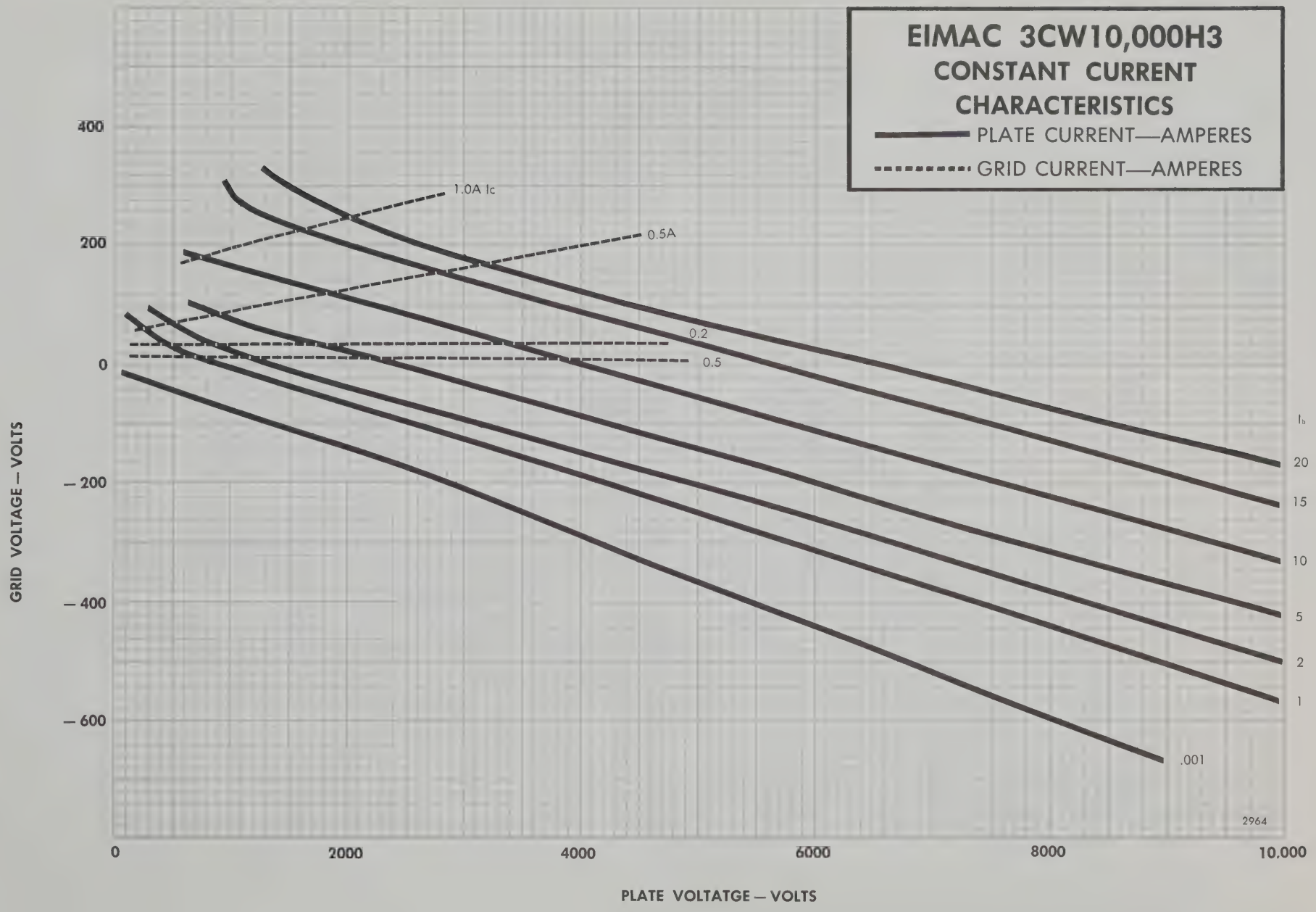
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	3.525	3.725	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.185
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.220	5.280	
R	.800	.860	
S	3.000	3.250	
T	4.250	4.400	
U	8.500	8.900	
V			.250
W	29°	31°	
X	5.950	6.050	
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390
AE			.0621

NOTES:
1. 12 MOUNTING HOLES IN EACH FLANGE.
2. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW10,000H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT—AMPERES
GRID CURRENT—AMPERES
1.0A Ic
0.5A
0.2
0.5
.001
Ib
20
15
10
5
2
1
2964
400
200
0
— 200
— 400
— 600
0
2000
4000
6000
8000
10,000
GRID VOLTAGE — VOLTS
PLATE VOLTATGE — VOLTS

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

3CX5000H3

INDUSTRIAL MEDIUM-MU AIR-COOLED POWER TRIODE



The EIMAC 3CX5000H3 is an air-cooled ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is conservatively rated at 5 kilowatts maximum plate dissipation with low pressure drop.

Input of 25 kilowatts is permissible up to 90 megahertz. Plentiful reserve emission is available from its 560 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe application.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		Volts
Current	73		78	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Input			53	$\mu\mu$f
Output			1.5	$\mu\mu$f
Grid-Plate			25	$\mu\mu$f
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	10 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Effective 4-1-66) © 1966 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 Volts
DC PLATE CURRENT	3.0 Amps
DC GRID VOLTAGE	—1000 Volts
DC GRID CURRENT	0.5 Amp
PLATE INPUT POWER	25 kW
PLATE DISSIPATION	5 kW

TYPICAL OPERATION*

DC Plate Voltage	7000	9000 Volts
DC Plate Current	2.65	2.52 Amps
DC Grid Voltage	—700	—900 Volts
DC Grid Current	0.192	0.184 Amps
Peak Positive Grid Voltage	230	230 Volts
Driving Power	179	208 Watts
Plate Input Power	18.55	22.7 kW
Plate Dissipation	4.1	4.1 kW
Plate Output Power	14.45	18.6 kW
Approximate Load Impedance	1245	1725 Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CX5000H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.5 ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Overcurrent protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.25 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 150 watts.

Plate Operation

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CX5000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

The maximum temperature rating for the external surfaces of the 3CX5000H3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated for frequencies below 30 MHz.

MINIMUM AIR FLOW REQUIREMENTS
(Anode-to-Base Air Flow)

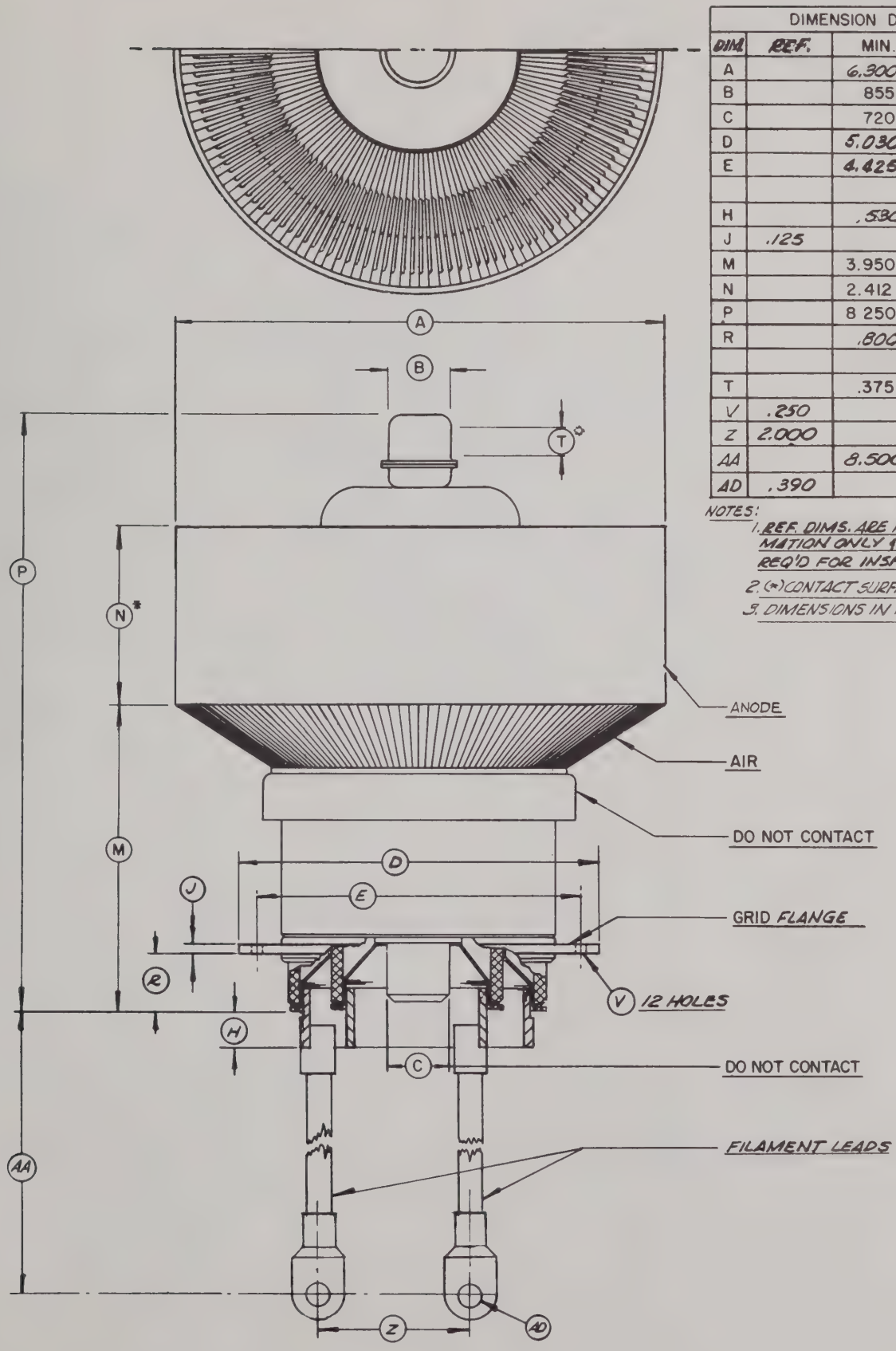
	Sea Level		5000 Feet	
Plate** Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
4000	98	0.24	118	0.29
5000	152	0.49	182	0.59
6000	236	1.00	283	1.2

**Since the power dissipated by the filament is about 560 watts and since grid dissipation can, under some circumstances, represent another 150 watts, allowance has been made in preparing this tabulation for an additional 710 watts dissipation.

Additional stem cooling air must be provided. 8 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by an 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling for 50°C ambient, 5000 ft. altitude, and 30 MHz or less.

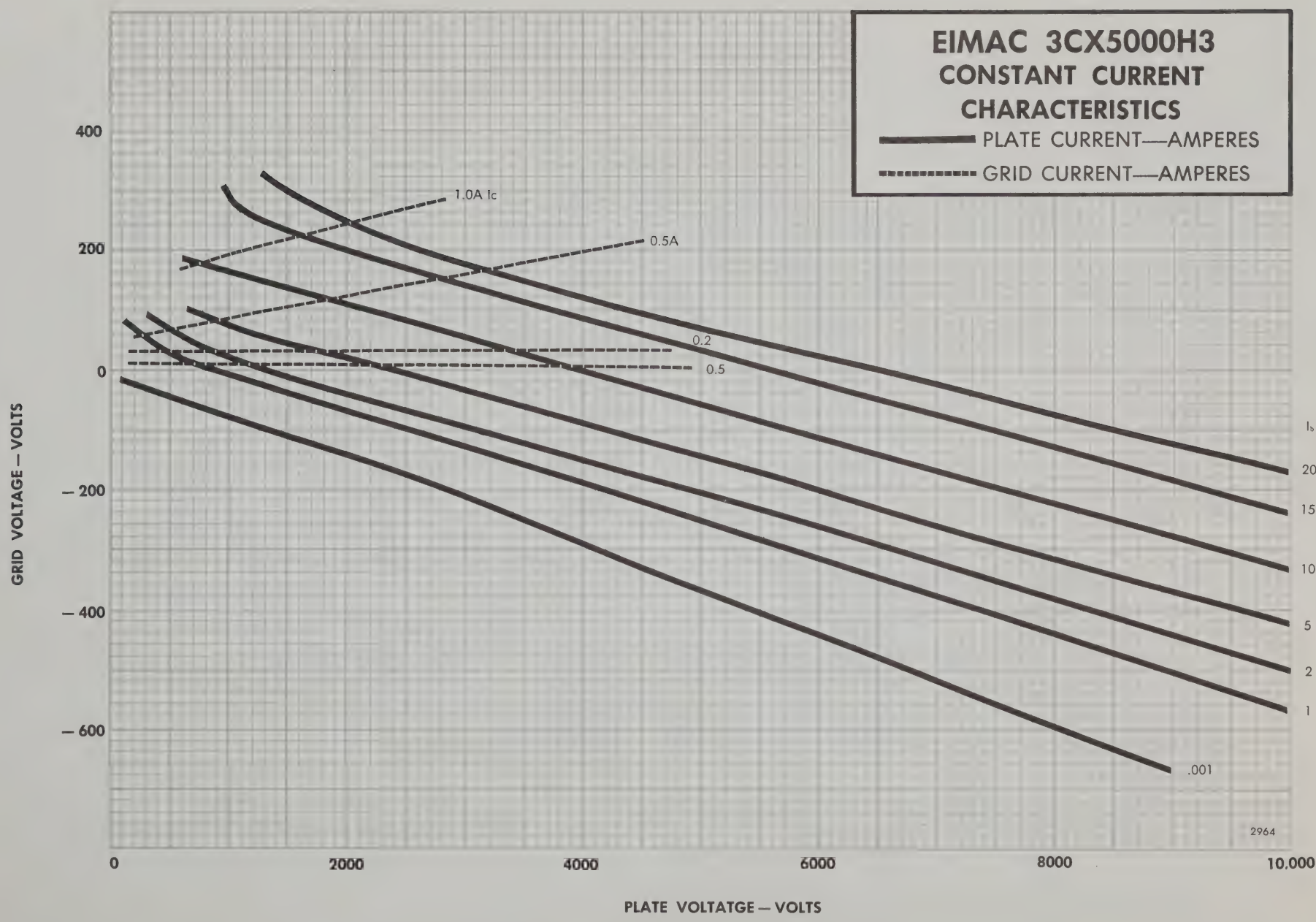
Special Applications

If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.



DIMENSION DATA			
DIM.	REF.	MIN.	MAX.
A		6.300	6.400
B		855	895
C		720	760
D		5.030	5.090
E		4.425	4.445
H		.530	.700
J	.125		
M		3.950	4.300
N		2.412	2.788
P		8 250	8.750
R		.800	.860
T		.375	
V	.250		
Z	2.000		
AA		8.500	9.000
AD	.390		

NOTES:
1. REF. DIMS. ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.
2. (*) CONTACT SURFACE
3. DIMENSIONS IN INCHES


EIMAC 3CX5000H3
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT—AMPERES
GRID CURRENT—AMPERES
1.0A Ic
0.5A
0.2
0.5
.001
Ib
20
15
10
5
2
1
2964
400
200
0
— 200
— 400
— 600
GRID VOLTAGE — VOLTS
0
2000
4000
6000
8000
10,000
PLATE VOLTATGE — VOLTS

Eimac®

EIMAC

A Division of Varian Associates

3CX10,000H3

MEDIUM-MU AIR-COOLED POWER TRIODE



The Eimac 3CX10,000H3 is an air-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is conservatively rated at 10 kilowatts of plate dissipation.

Input of 40 kilowatts is permissable up to 90 megacycles. Plentiful reserve emission is available from its 750 watt filament. The grid structure is rated at 250 watts, making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		Volts
Current	94		104	Amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	μμf
Plate-Filament	1.2		1.5	μμf
Grid-Plate	30		38	μμf
Frequency for Maximum Ratings			90	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperature	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 Pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	4.0 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	0.6 AMP
PLATE INPUT POWER	40 KW
PLATE DISSIPATION	10 KW

*Loaded Conditions

TYPICAL OPERATION*

DC Plate Voltage	7000	9000 Volts
DC Plate Current	4.0	4.0 Amps
DC Grid Voltage	—670	—930 Volts
DC Grid Current	.275	.430 Amps
Peak Positive Grid Voltage	340	390 Volts
Driving Power	260	570 Watts
Plate Input Power	28	36 kW
Plate Dissipation	9	7 kW
Plate Output Power	19	29 kW
Approximate Load Impedance	720	1100 Ohms

NOTE: "Typical Operation" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

(Effective 3-15-66) Copyright 1966 by Varian Associates

APPLICATION

ELECTRICAL

Filament — The rated filament voltage for the 3CX10,000H3 is 7.5 volts. Filament voltage, as measured at the tube, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

Control Grid Operation — The grid current rating is 0.6 ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.2 to 0.4 amp grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 250 watts.

Plate Operation — Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation—The 3CX10,000H3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting —The 3CX10,000H3 must be mounted vertically, either base up or down. A grid flange is provided for bolting to a grid strap or a grid deck. Heavy flexible leads are provided for the filament voltage connection.

Cooling — The maximum temperature rating for the external surfaces of the 3CX10,000H3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated.

	Sea Level		5000 Feet	
Plate** Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
4000	85	0.18	105	0.21
6000	145	0.38	175	0.46
8000	215	0.68	260	0.82
10,000	295	1.08	360	1.32
12,000	390	1.62	470	1.95

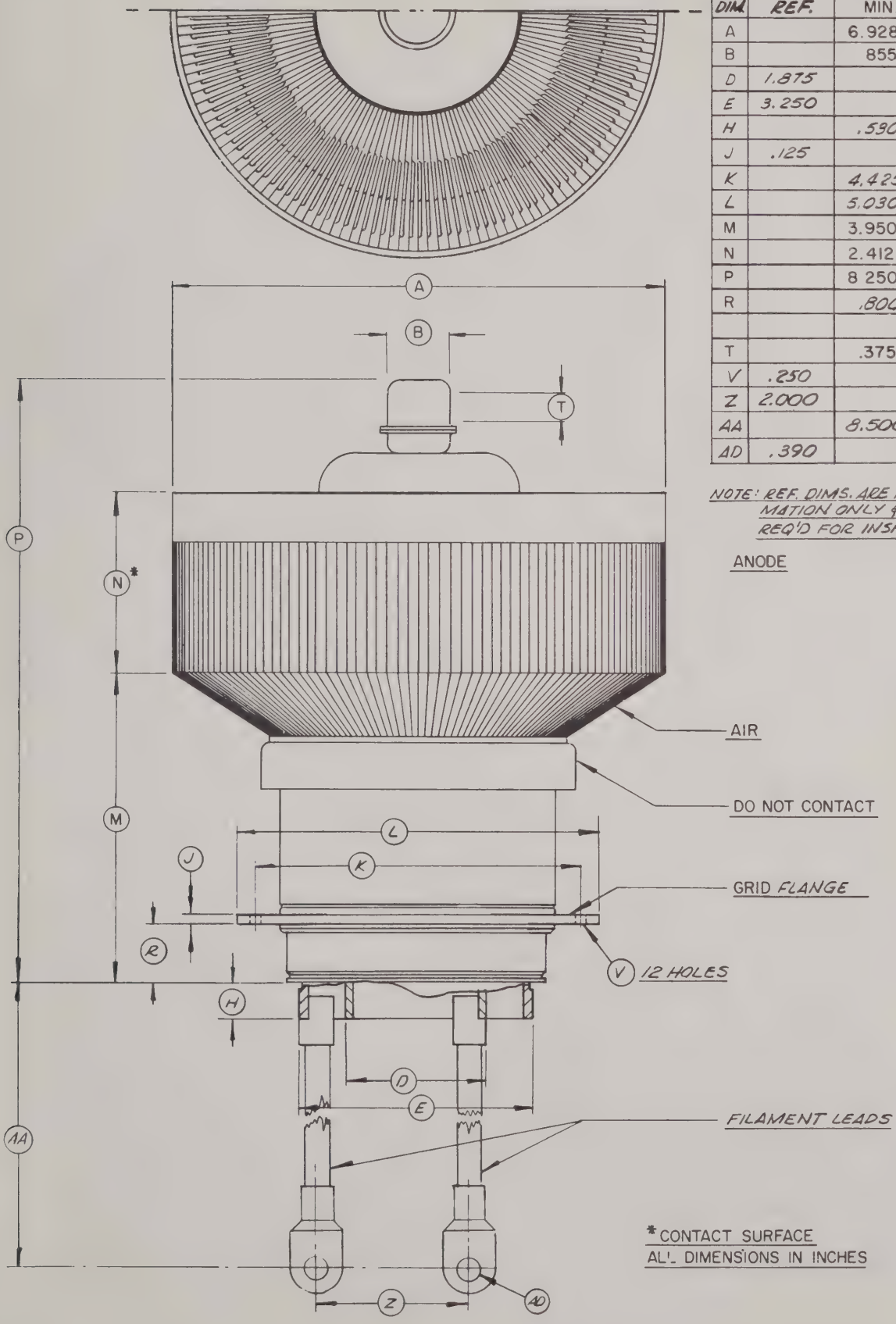
**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 25 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

Additional stem cooling air must be provided. 10 CFM of air directed against the center filament contact ¾″ below the outer filament contact ring by a 1½″ I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

Special Application — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., Eimac, A Division of Varian Associates Inc., 301 Industrial Way, San Carlos, Calif. for information and recommendations.

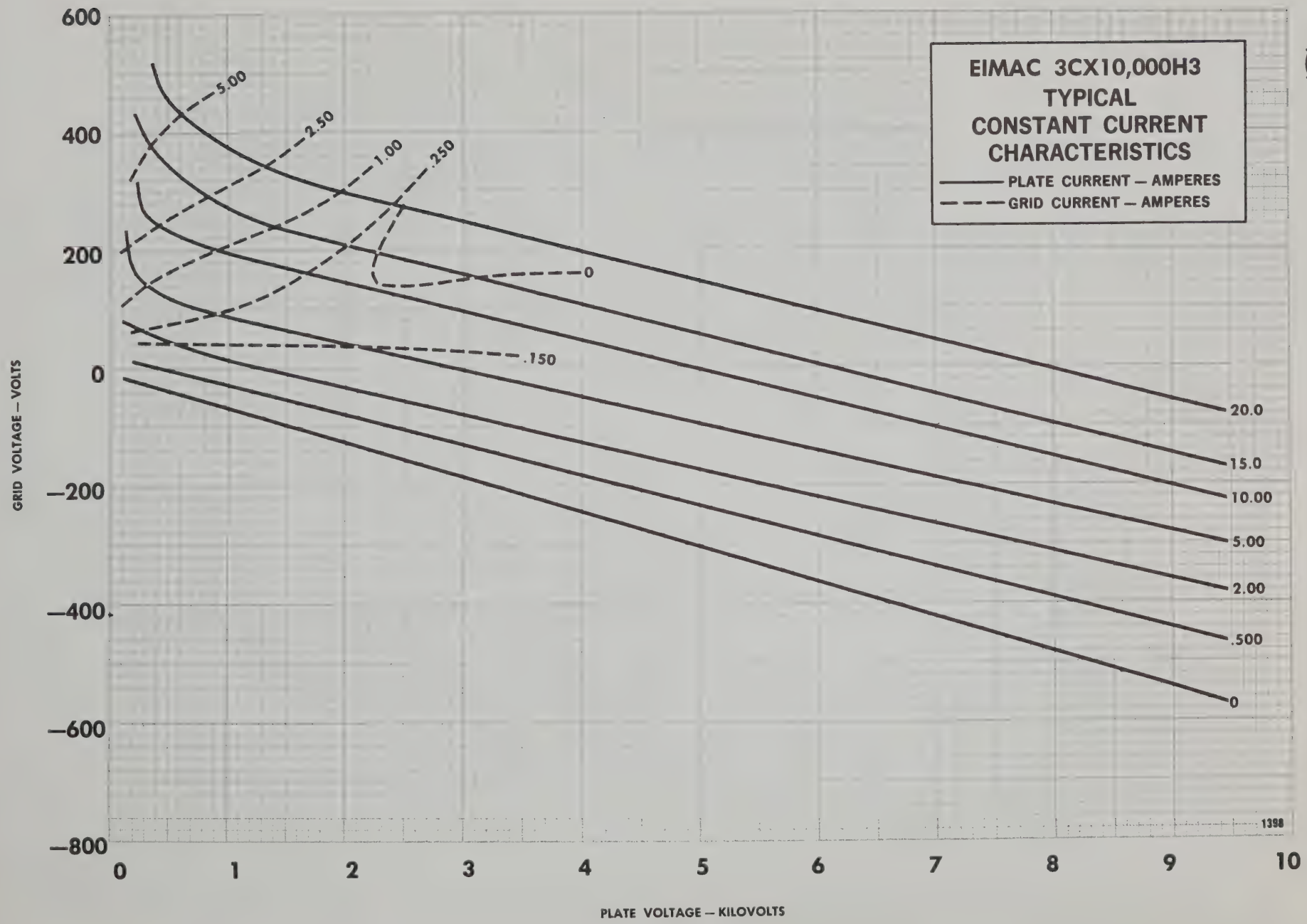
DIMENSION DATA			
DIM.	REF.	MIN.	MAX.
A		6.928	7.050
B		855	895
D	1.875		
E	3.250		
H		.590	.700
J	.125		
K		4.425	4.445
L		5.030	5.090
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.800	.860
T		.375	
V	.250		
Z	2.000		
AA		8.500	9.000
AD	.390		

NOTE: REF. DIMS. ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.



*CONTACT SURFACE

ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
5.00
2.50
1.00
.250
0
.150
20.0
15.0
10.00
5.00
2.00
.500
0
1398
600
400
200
0
—200
—400
—600
—800
0
1
2
3
4
5
6
7
8
9
10
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — KILOVOLTS

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

3CX15,000H3

INDUSTRIAL MEDIUM-MU AIR-COOLED POWER TRIODE

The EIMAC 3CX15,000H3 is an air-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air- cooled anode is rated at 15 kilowatts of plate dissipation.

Full ratings apply up to 90 megacycles. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe application.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		Volts
Current	152		172	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Grid-Filament	48		58	$\mu\mu$f
Plate-Filament	1.2		1.5	$\mu\mu$f
Grid-Plate	30		38	$\mu\mu$f
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	13 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Effective 4-1-66) © 1966 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,000 Volts
DC PLATE CURRENT	6.0 Amps
DC GRID VOLTAGE	—1000 Volts
DC GRID CURRENT	1.0 Amps
PLATE INPUT POWER	60 kW
PLATE DISSIPATION	15 kW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000 Volts
DC Plate Current	6.0	5.0 Amps
DC Grid Voltage	—600	—800 Volts
DC Grid Current	660	542 mA
Peak Positive Grid Voltage	440	400 Volts
Driving Power	660	650 Watts
Plate Input Power	42	50 kW
Plate Dissipation	12	8.8 kW
Plate Output Power	30	41.2 kW
Approximate Load Impedance	600	1025 Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

For the 3CX15,000H3 the rated filament voltage is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at 6.3 volts plus or minus five percent for long tube life and consistent performance. Maximum life will be obtained by operation at minus 5 percent.

Control Grid Operation

The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Overcurrent protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation

Maximum plate voltage rating of 12,000 volts and maximum plate current of 6.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CX15,000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

The maximum temperature rating for the 3CX15,000H3 is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megacycles.)

MINIMUM AIR FLOW REQUIREMENTS
(Anode-to-Base Air Flow)

	Sea Level		5000 Feet	
Plate* Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
7500	361	1.63	433	1.96
10,000	606	3.26	728	3.92
15,000	1260	10.00	1510	12.00

*Since the power dissipated by the filament represents about 1100 watts and since grid dissipation can, under some conditions represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1600 watts.

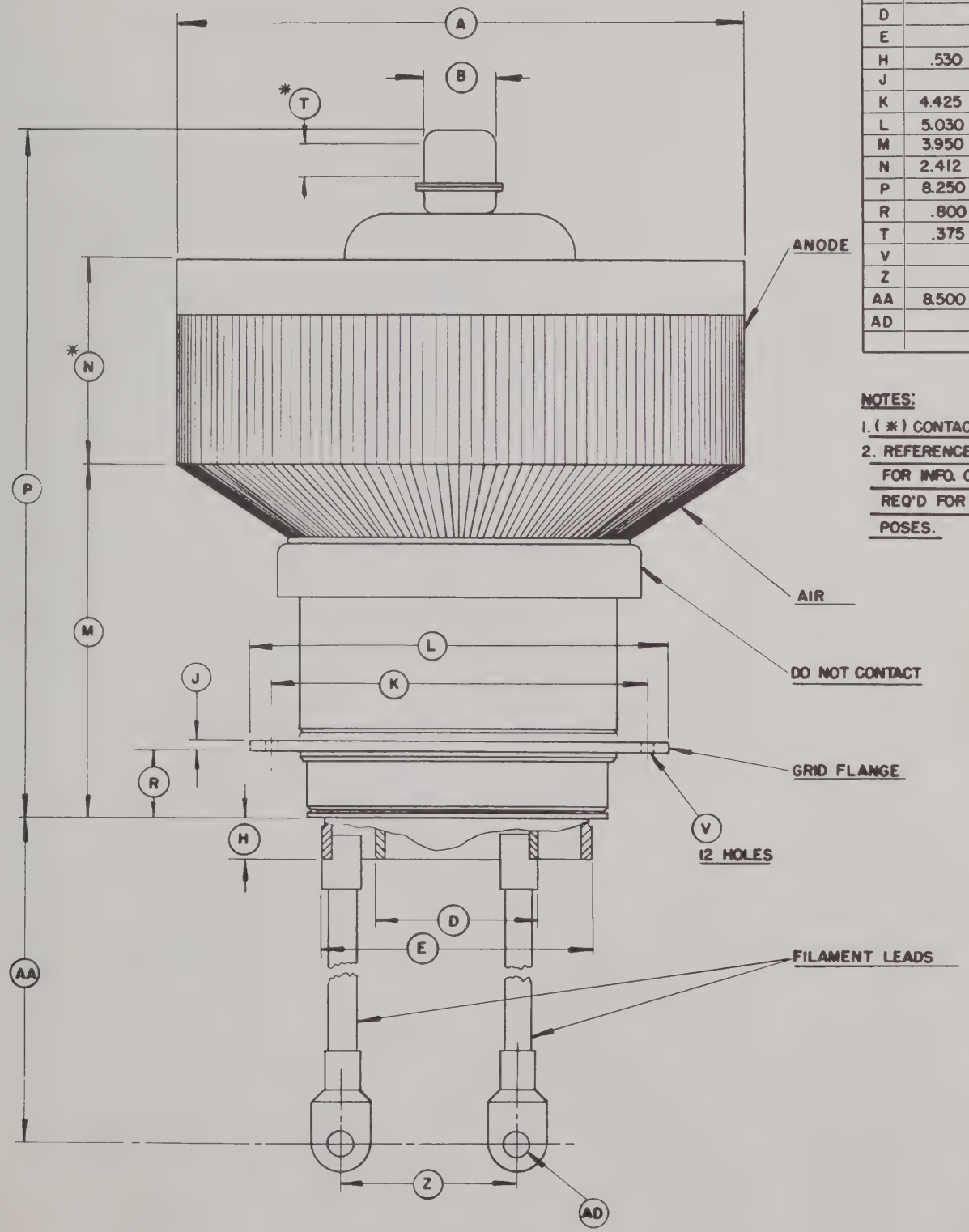
Additional stem cooling air must be provided. 16 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by a 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling for maximum frequency of 30 MHz, 50°C ambient, and 5000 ft. altitude.

Special Application

If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Product Manager, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	6.928	7.050	
B	.855	.895	
D			1.875
E			3.250
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M	3.950	4.300	
N	2.412	2.788	
P	8.250	8.750	
R	.800	.860	
T	.375		
V			.250
Z			2.000
AA	8.500	9.000	
AD			.390



NOTES:

1. (*) CONTACT SURFACE
2. REFERENCE DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.

EIMAC 3CX15,000H3

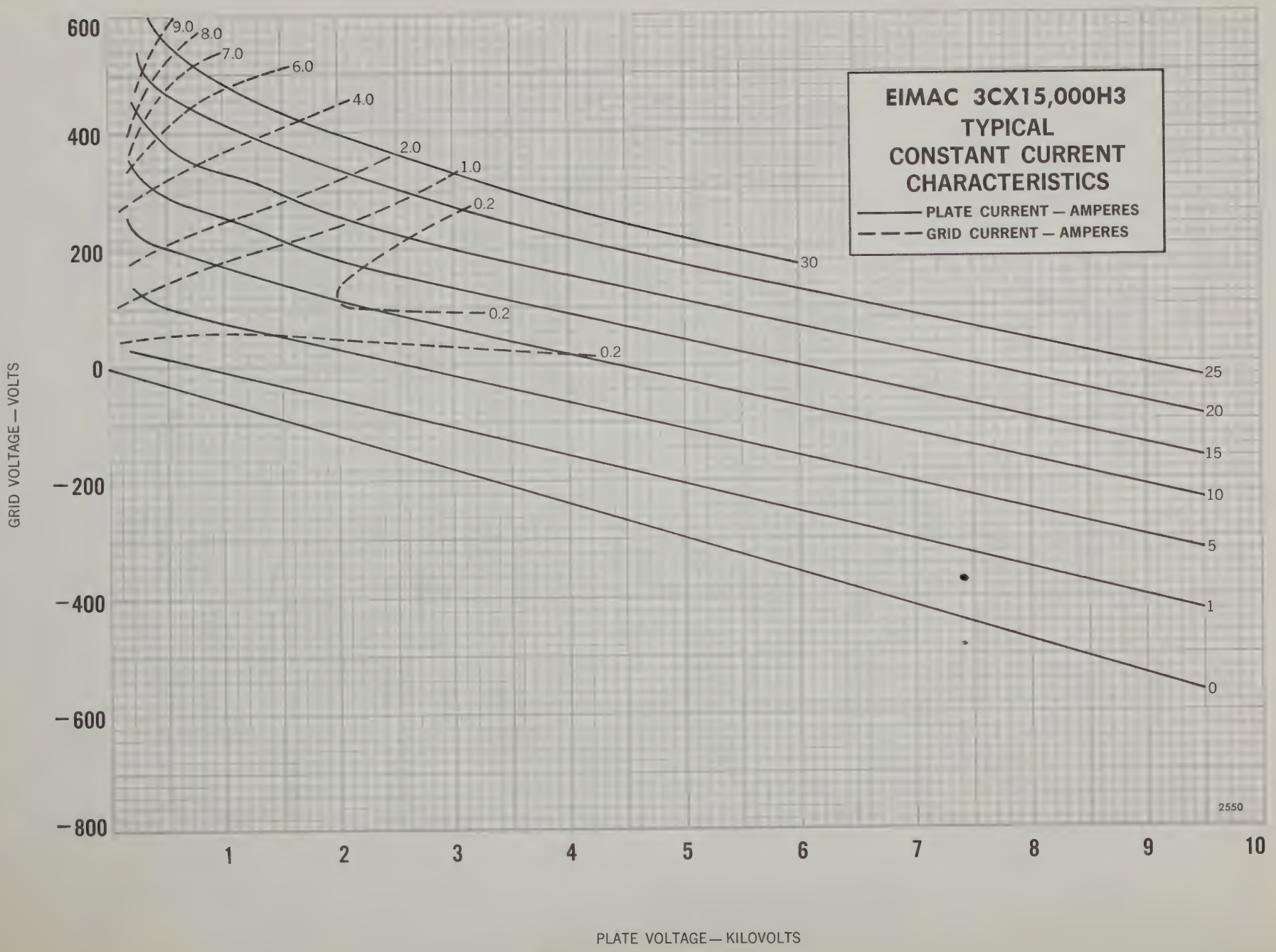

EIMAC 3CX15,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — KILOVOLTS
600
400
200
0
−200
−400
−600
−800
1
2
3
4
5
6
7
8
9
10
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
30
25
20
15
10
5
1
0
2550

TABLE OF CONTENTS

VOLUME I

GENERAL — Effective Date

EIMAC Field Representatives 6-1-65
Tube Type Numbering System 4-3-58
Distributors 5-15-65
EIMAC and EIA Tube Number Cross Reference Sheet 3-65
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet .....
Power Frequency Chart for Power Grid ..

DIODES — RECTIFIERS — PULSE MODULATORS

2-01C 1-22-60
2-25A 7-1-52
2-50A 7-1-52
2-150D 12-15-65
2-240A 10-21-59
2-450A 11-3-59
2-2000A 7-1-52
2X3000F 6-1-63
250R 12-15-65
253 7-1-52
575A & 673 3-16-64
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020(100R) 2-1-52
4PR60B/8252 2-15-62
4PR65A/8187 2-15-63
4PR125A/8247 7-15-62
4PR250C/8248 12-1-63
4PR400A/8188 3-15-66
4PR1000A/8189 12-15-65
6C21 12-15-65
KY21A 1-2-63
RX21A 1-2-63

TRIODES

2C39A 10-25-62
2C39WA 2-7-58
3-400Z/8163 7-15-65
3-1000Z/8164 4-9-64
3C24 11-1-51
3CPN10A5/7815 1-1-63
3CPX100A5/7815R 1-1-63
3CV30,000A3 10-1-63
3CW20,000A1 1-1-63
3CW20,000A3 5-1-63
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 11-1-63
3CW30,000H3 2-1-65
3CX100A5/7289 & 3CX100F5/8250 5-1-62
3CX1000A7/8283 3-1-63
3CX2500A3/8161 12-15-64
3CX2500F3 12-15-65
3CX2500H3 3-15-66
3CX10,000A1/8158 8-14-64
3CX10,000A3/8159 8-15-64

TRIODES (Continued) — Effective Date

3CX10,000A7/8160 11-1-63
3CX15,000A3 4-11-64
3W5000A1/8240 8-15-64
3W5000A3/8242 6-1-64
3W5000F1/8241 2-18-63
3W5000F3/8243 10-20-61
3X2500A3/8161 11-20-61
3X2500F3/8251 6-30-64
3X3000A1/8238 2-18-63
3X3000A7 5-20-63
3X3000F1/8239 2-18-63
3X3000F7/8162 5-5-61
25T 12-15-65
35T 12-30-57
*35TG 5-1-62
75TH 12-15-65
75TL 1-2-52
100TH 4-1-49
100TL ..... ———
*152TH 11-25-52
*152TL 1-1-44
250TH 5-1-53
250TL 1-1-61
304TH 4-10-53
304TL 12-15-65
450TH 12-15-65
450TL 12-15-65
592/3-200A3 7-1-54
750TL 12-15-65
1000T 12-15-65
1500T 3-18-59
2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7211 9-1-64
7480 10-15-64

TETRODES — PENTODES

4-65A/8165 5-1-62
4-125A 12-15-65
4-250A/5D22 5-1-62
4-400A 9-1-65
4-1000A/8166 7-1-62
4CN15A 1-1-63
4CV8000A 11-8-62
4CV20,000A 11-8-62
4CV35,000A 12-3-62
4CV100,000C/8351 3-15-65
4CW2000A 11-19-63
4CW10,000A 4-15-63
4CW50,000C/8350 10-10-62
4CX125C,F 1-1-63
4CX250B/7203 & 4CX250F/7204 7-15-62
4CX250K/8245 & 4CX250M/8246 1-28-63
4CX250R 6-16-61
4CX300A/8167 12-1-63
4CX300Y 11-1-63

TETRODES—PENTODES (Continued) — Effective Date

4CX350A/8321 & 4CX350F/8322 6-15-65
4CX600A 5-7-63
4CX1000A/8168 11-4-63
4CX1000K/8352 1-1-64
4CX1500B 1-15-66
4CX3000A/8169 3-1-63
4CX5000A/8170 10-1-64
4CX5000R/8170W 1-1-63
4CX10,000D/8171 1-20-62
4CX15,000A/8281 10-10-62
4CX35,000C/8349 11-1-63
4W300B 6-16-60
4W20,000A/8173 4-15-64
4X150A & 4X150D 6-15-60
4X150G/8172 8-15-63
4X150R/8296 & 4X150S/8297 5-15-62
4X500A 1-1-64
4E27A/5-125B 8-15-52
5-500A 11-15-65
5CX1500A 2-15-65

OTHER PRODUCTS

VS-2, 4, 5, & 6 12-1-63
100 IG Ionization Gauge 6-15-53
Preformed Contact Finger Stock 1-15-62
HR Heat Dissipating Connectors 12-1-65
CS-8301 Laser Tube Assembly 10-5-64
EO-101 Detonator EO-201 Squib 11-15-64
X6004 Ultraprobe 6-1-65
X6006 Docking Light 10-1-65
X6007 Nuclear Battery 9-15-65
X6065 High Vacuum, High Current Electrical Feedthrough 3-15-66
SK-300A 11-1-64
SK-306, SK-316 5-21-63
SK-400 4-1-56
SK-406, SK-416, SK-426 11-1-65
SK-410 11-15-62
SK-500 3-1-56
SK-506, SK-516 8-15-64
SK-510 5-4-63
SK-600A, SK-610A 11-1-65
SK-606, SK-626, SK-636B 5-24-63
SK-620, SK-620A 1-15-63
SK-630, SK-630A 1-18-63
SK-640 2-15-66
SK-650, SK-655 1-15-66
SK-700, SK-710, SK-606 1-20-58
SK-711A 5-9-63
SK-740 5-9-63
SK-760, SK-770 5-9-63
SK-800B, SK-806 4-9-64
SK-810, SK-806 4-9-64
SK-860, SK-870 5-9-63
SK-890, SK-806 4-9-64
SK-900, SK-906 6-1-60
SK-1300 5-9-63
SK-1306, SK-1406 5-17-63
SK-1400A, SK-1470A 5-9-63

*Not recommended for New Equipment Design.

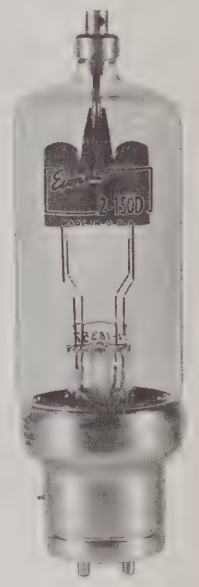
Effective Date 4-15-66

EIMAC

A Division of Varian Associates

2-150D

HIGH-VACUUM RECTIFIER



The Eimac 2-150D is a high vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-150D has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 30,000 volts. Cooling is by convection and radiation.

A single 2-150D will deliver 200 milliamperes at 11,800 volts to a capacitor-input filter with 10,600 volts single-phase supply. Four 2-150D's in a bridge circuit will deliver 500 milliamperes at 19,000 volts to a choke-input filter with 21,200 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	13.0 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	8.88 inches
Diameter	2.50 inches
Net Weight	9 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	30,000 MAX. VOLTS
PLATE DISSIPATION	90 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	3.0 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application."

(Revised 12-15-65) Copyright 1952, 1965 by Varian Associates

APPLICATION

MECHANICAL

Mounting — The 2-150D must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling — The 2-150D is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq," a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd Street, New York 11, N.Y.

ELECTRICAL

Filament Operation — For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-150D reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 2-150D begins to show color as the maximum plate dissipation rating of 90 watts is approached. The maximum peak inverse voltage rating of 30,000 volts should not be exceeded at any time.

Performance — The accompanying table shows some maximum performance capabilities of the 2-150D when used as a power-supply rectifier.

2-150D MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter D-C Output Voltage (volts)	Capacitor-Input Filter D-C Output Current (ma)	Choke-Input Filter D-C Output Voltage (volts)	Choke-Input Filter D-C Output Current (ma)
Single-Phase, Half-Wave	10,600	11,800	200	.....	.....
Single-Phase, Full-Wave	10,600[1]	11,800	400	9500	500
Single-Phase, Bridge	21,200	23,600	400	19,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings — Plate dissipation rather than peak current usually limits the d-c current which the 2-150D is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter — The maximum d-c current rating of the 2-150D is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_f in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter — The 2-150D is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-150D when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities.

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-150D, which may be taken as 300 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the load maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-150D is 30,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-150D is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-150D is 500 milliamperes.

The plate characteristic curve for the 2-150D serves as a guide to special applications. The maximum plate dissipation rating of 90 watts, the maximum peak inverse voltage rating of 30,000 volts, and the maximum peak plate current of 3.0 amperes must not be exceeded.

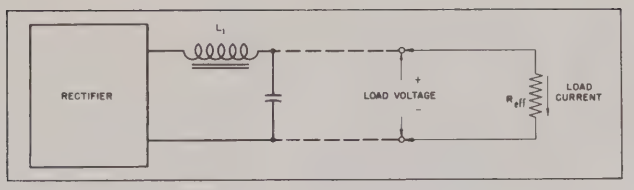
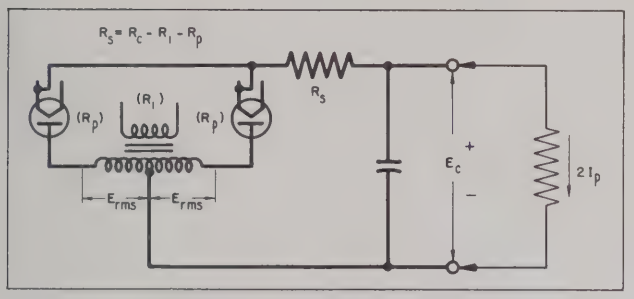
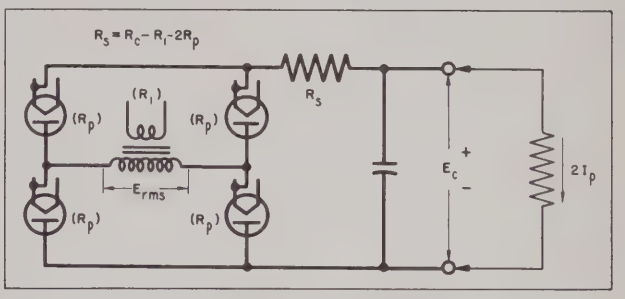


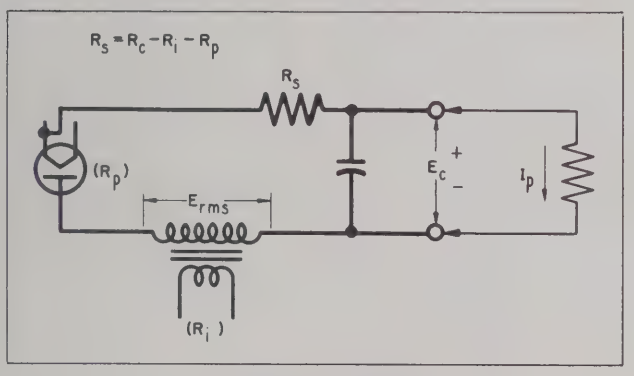
Fig. 1. Rectifier with Choke-Input Filter



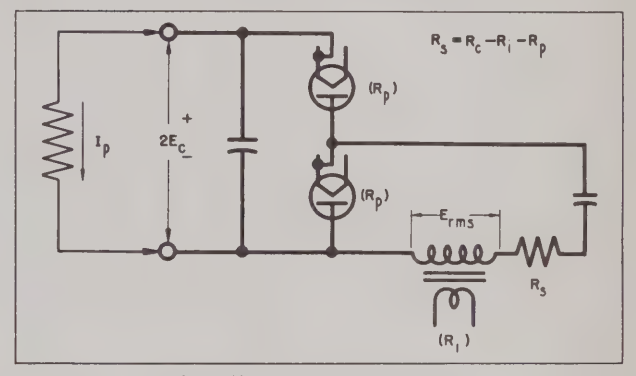
a. Full-Wave Center-Tapped Rectifier



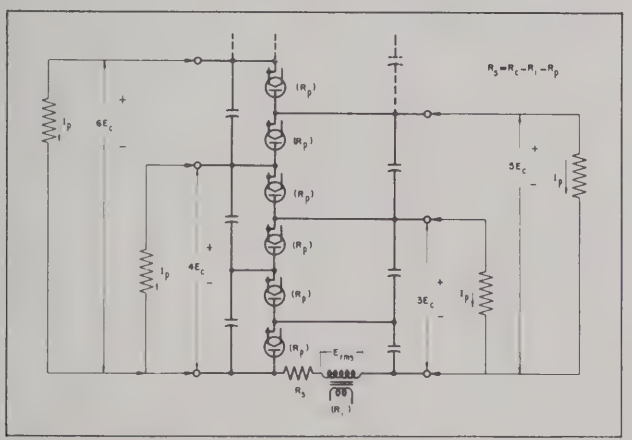
b. Full-Wave Bridge Rectifier



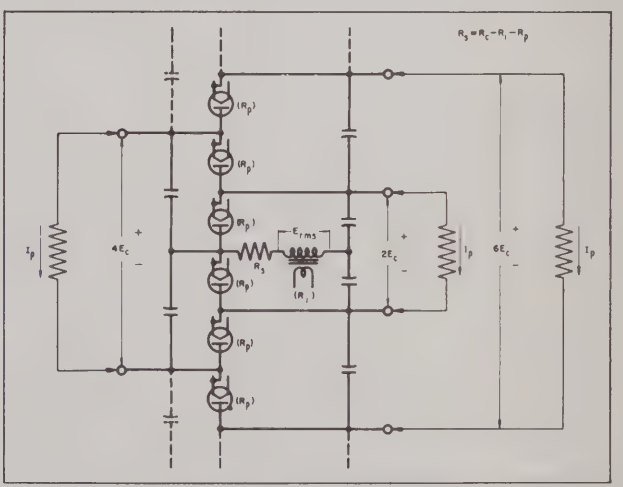
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



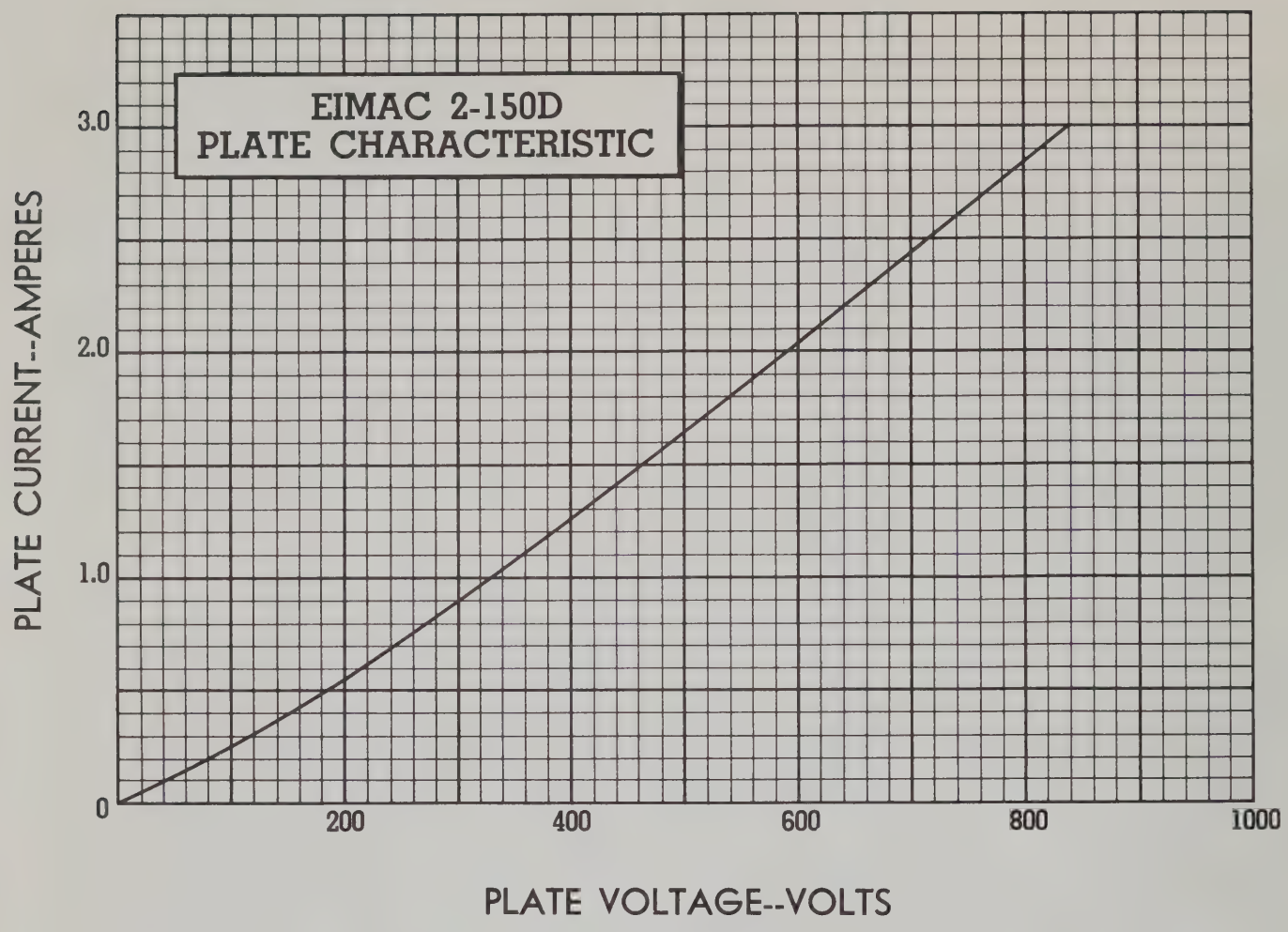
f. Full-Wave Voltage Multiplier

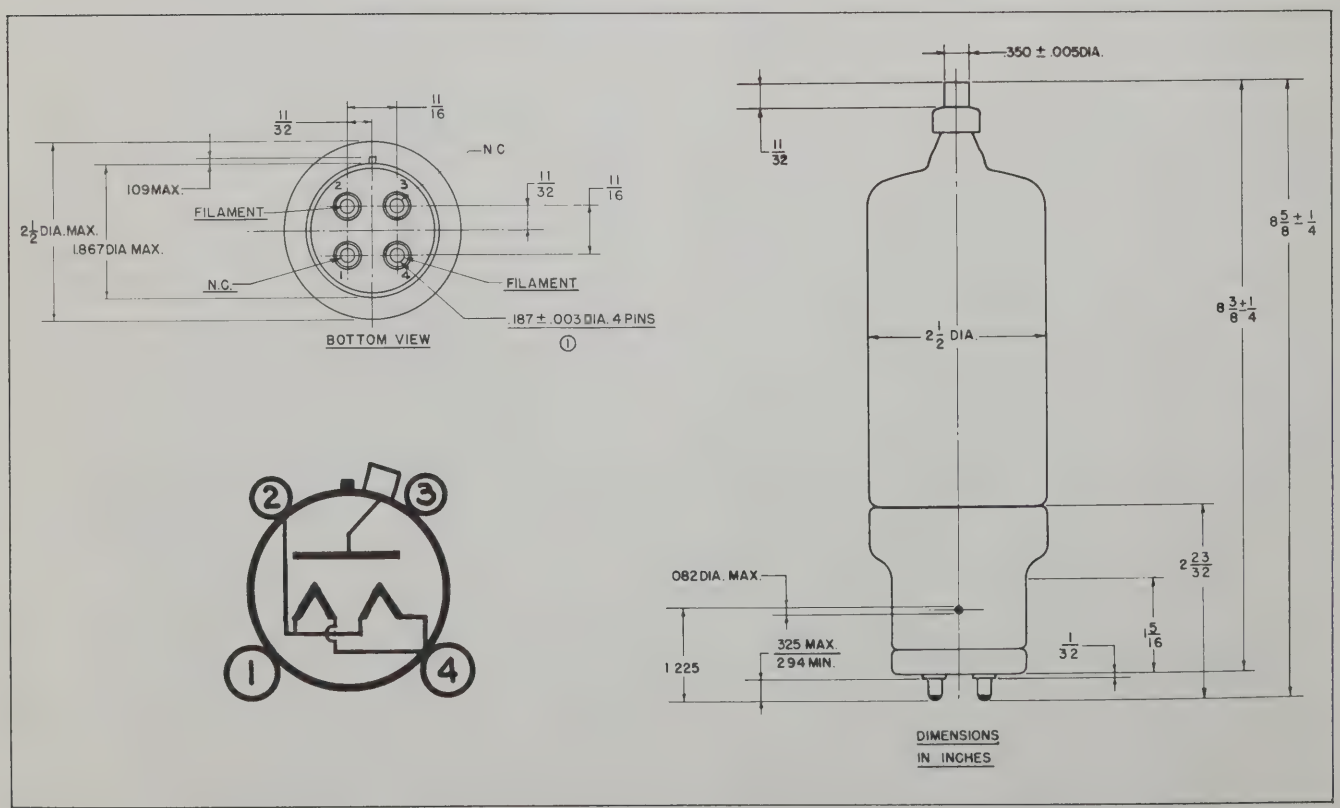
Eimac 2-150D Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	150	175	200	225	250	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	0.7	1.6	3.9	9.6	27	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.78	0.82	0.90	1.07	1.50	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.2	2.4	2.6	3.0	4.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 2-150D Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 300 ohms (150 ohms for two tubes in parallel)





Printed in U.S.A. 882

EIMAC

A Division of Varian Associates

8251
3CX2500F3

MEDIUM MU TRIODE

The Eimac 3CX2500F3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500F3 is an exact replacement for the Eimac 3X2500F3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube is equipped with flexible filament and grid leads which simplify socketing and equipment design for industrial and communication frequencies below 30 megacycles.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	48		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances:				
Grid-Plate	16.8		23.2	uuf
Grid-Filament	29.2		40.2	uuf
Plate-Filament	0.6		1.2	uuf
Transconductance (Ib = 830 ma., Eb = 3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			30	mc

MECHANICAL

Base	See outline drawing
Mounting	Vertical, base down or up
Maximum Anode Core and Seal Temperatures	250°C
Cooling	Forced Air
Maximum Over-all Dimensions:	
Length (Does not include filament connectors)	8.6 inches
Diameter	4.16 inches
Length of Filament Connectors (Approximate)	9.5 inches
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier,
Class-C FM or Telegraphy (Key-Down Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	5000	6000 volts
D-C Plate Current	2.5	2.5	2.08 amps
D-C Grid Voltage	—300	—450	—500 volts
D-C Grid Current	245	265	180 ma
Peak R-F Grid Input Voltage*	580	750	765 volts
Driving Power*	142	197	136 watts
Grid Dissipation*	68	78	46 watts
Plate Input Power	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Output Power	7500	10,000	10,000 watts

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier,
Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5500 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	1670 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	4500	5000 volts
D-C Plate Current	1.67	1.47	1.25 amps
D-C Grid Voltage	—450	—500	—550 volts
D-C Grid Current*	180	140	150 ma
Peak R-F Grid Input Voltage*	685	715	760 volts
Driving Power*	125	100	115 watts
Grid Dissipation*	43	30	32 watts
Plate Input Power	6670	6615	6250 watts
Plate Dissipation	1670	1315	950 watts
Plate Output Power	5000	5300	5300 watts

*Approximate values.

(Revised 12-15-65) Copyright 1964, 1965 by Varian Associates

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	4000	5000	6000 volts
D-C Grid Voltage[1]	—150	—190	—240 volts
Zero-Signal D-C Plate Current	0.6	0.5	0.4 amps
Max-Signal D-C Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

Cooling —

Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 mc, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C and 50°C ambient air are tabulated below (for operation below 30 mc).

Anode-to-Base Air Flow[1]				
	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air-Flow				
	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1]When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Filament Voltage —

The filament voltage as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts. Tube life may be extended by operation at the lower end of this range.

Bias Voltage —

There is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

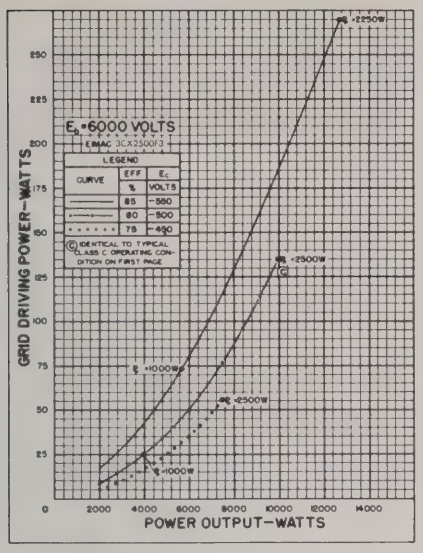
Plate Voltage —

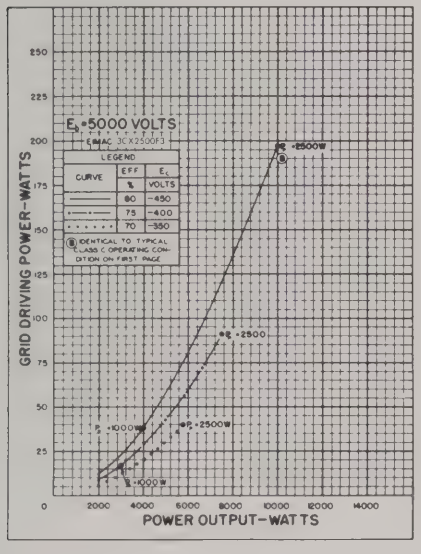
The plate-supply voltage for the 3CX2500F3 should not exceed 6000 volts. In most cases there is little advantage in using plate supply voltages higher than those given under "Typical Operation for the power output desired.

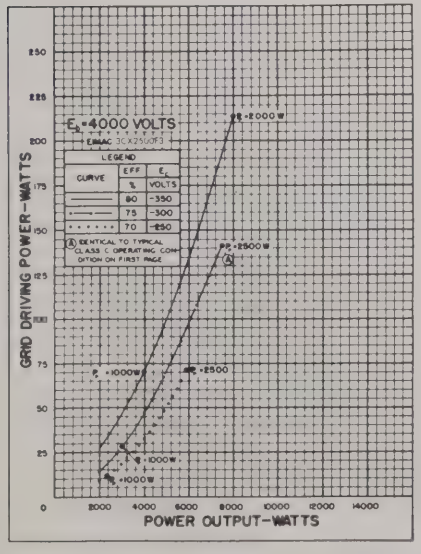
Grid Dissipation —

The power dissipated by the grid of the 3CX2500F3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

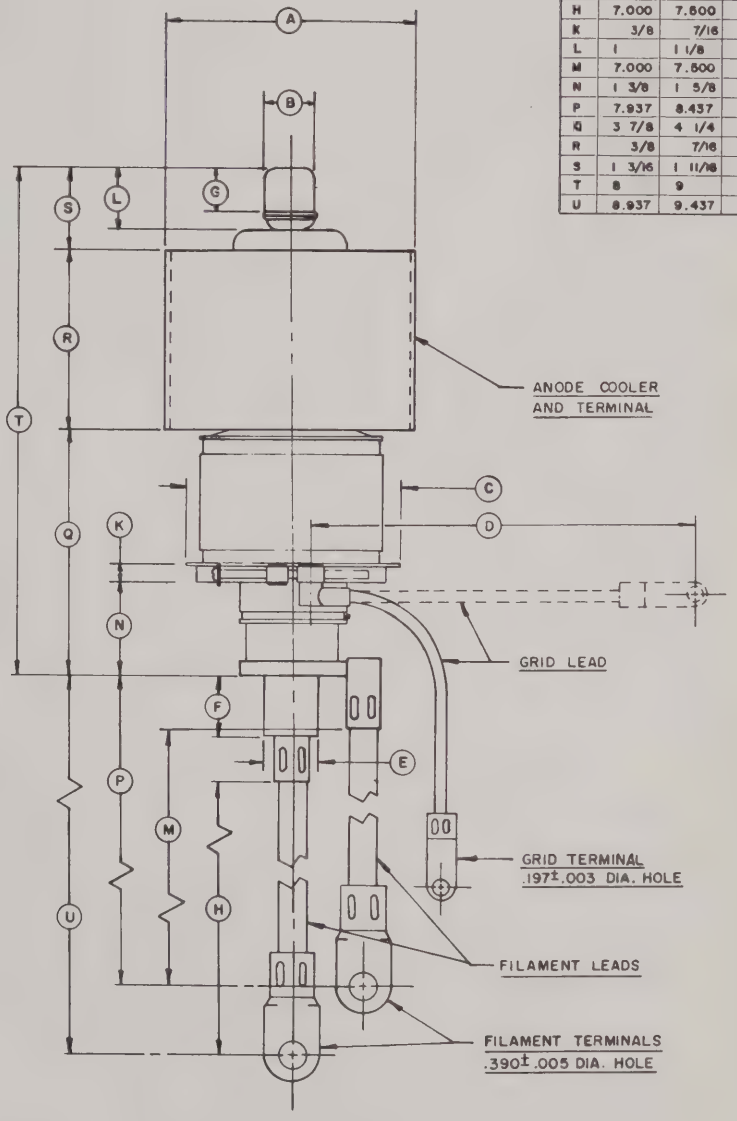
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





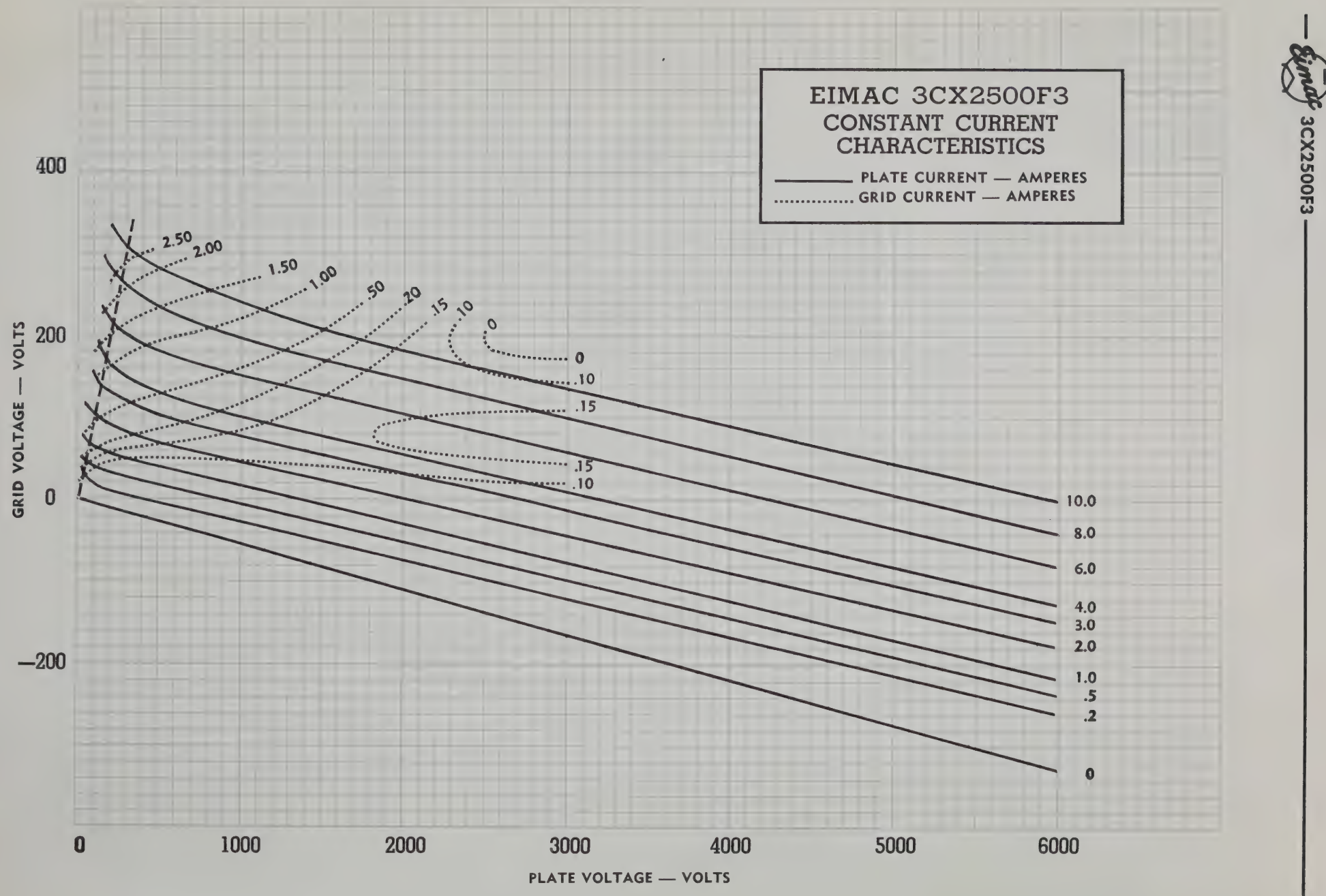


DIMENSIONAL DATA			
REF.	MIN.	MAX	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	11/16	13/16	
H	7.000	7.500	
K	3/8	7/16	
L	1	1 1/8	
M	7.000	7.500	
N	1 3/8	1 5/8	
P	7.937	8.437	
Q	3 7/8	4 1/4	
R	3/8	7/16	
S	1 3/16	1 11/16	
T	8	9	
U	8.937	9.437	



DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4,000, 5000 and 6000 volts respectively.


EIMAC 3CX2500F3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS

EIMAC

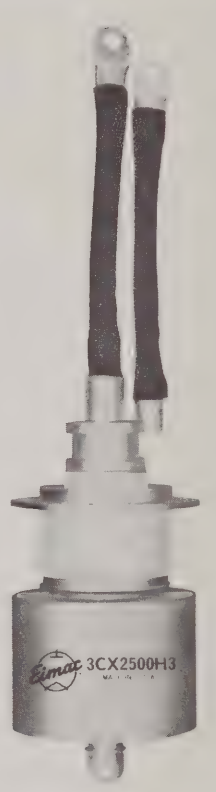
A Division of Varian Associates

3CX2500H3

MEDIUM-MU AIR-COOLED POWER TRIODE

The Eimac 3CX2500H3 is an air-cooled ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is conservatively rated at 2.5 kilowatts of plate dissipation with low air flow and pressure drop.

Input of 12.5 kilowatts is permissable up to 75 megacycles. Plentiful reserve emission is available from its 390 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten					
	Voltage		7.5		Volts
	Current	48		53	Amps
Amplification Factor			20		
Interelectrode Capacitances, Grounded Cathode:					
	Grid-Filament	29.2		40.2	μμf
	Plate-Filament	0.6		1.2	μμf
	Grid-Plate	16.8		23.2	μμf
Frequency for Maximum Ratings				75	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperature	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	6.5 Pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	0.4 AMP
PLATE INPUT POWER	12.5 KW
PLATE DISSIPATION (Nominal)	2.5 KW

*Loaded Conditions

TYPICAL OPERATION*

DC Plate Voltage	4000	6000 Volts
DC Plate Current	2.5	2.08 Amps
DC Grid Voltage	—300	—500 Volts
DC Grid Current	.245	.180 Amps
Peak Positive Grid Voltage	280	265 Volts
Driving Power	142	136 Watts
Plate Input Power	10,000	12,500 kW
Plate Dissipation	2,500	2,500 kW
Plate Output Power	7,500	10,000 kW
Approximate Load Impedance	910	1,625 Ohms

NOTE: "Typical Operation" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

(Effective 3-15-66) Copyright 1966 by Varian Associates

APPLICATION

ELECTRICAL

Filament — The rated filament voltage for the 3CX2500H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation — The grid current rating is 0.4 ampere dc. This value should not be exceeded for more than very short periods such as during tuning .Over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.275 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 150 watts.

Plate Operation — Maximum plate voltage rating of 6000 volts and maximum plate current of 2.5 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 12.5 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation — The 3CX2500H3 is usable to 110 Mc. At this frequency, plate voltage must be reduced to 4000 volts in Class C service.

MECHANICAL

Mounting — The 3CX2500H3 must be mounted vertically either base up or down. A mounting flange is provided on the grid terminal to allow bolting the tube to a grid deck or a strap. Filament voltage is applied through two heavy flexible leads.

Cooling — Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 mc, additional air flow must be provided. Sea level and 5000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 mc).

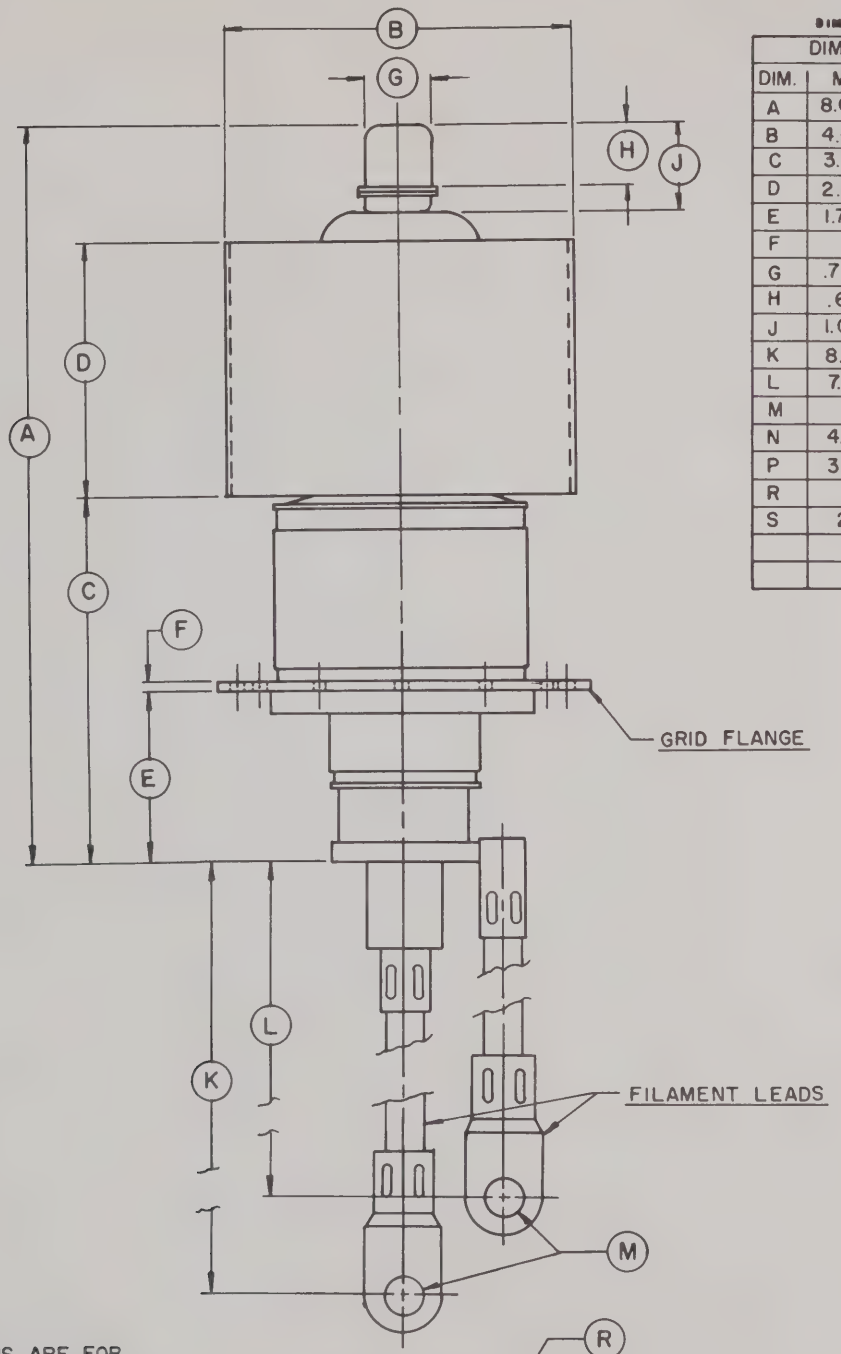
Anode-to-Base Air Flow				
	Sea Level		5000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	0.6	40	0.74
2500	66	1.25	79	1.49

Base-to-Anode Air Flow				
	Sea Level		5000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	0.6	39	0.74
2500	57	1.0	68	1.23

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 500 watts.

Additional stem cooling air must be provided. 14 CFM of air directed against the center rod ½" below the outer filament contact ring by a 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

Special Application — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Division, Eimac, 301 Industrial Way, San Carlos, Calif. for information and recommendations.

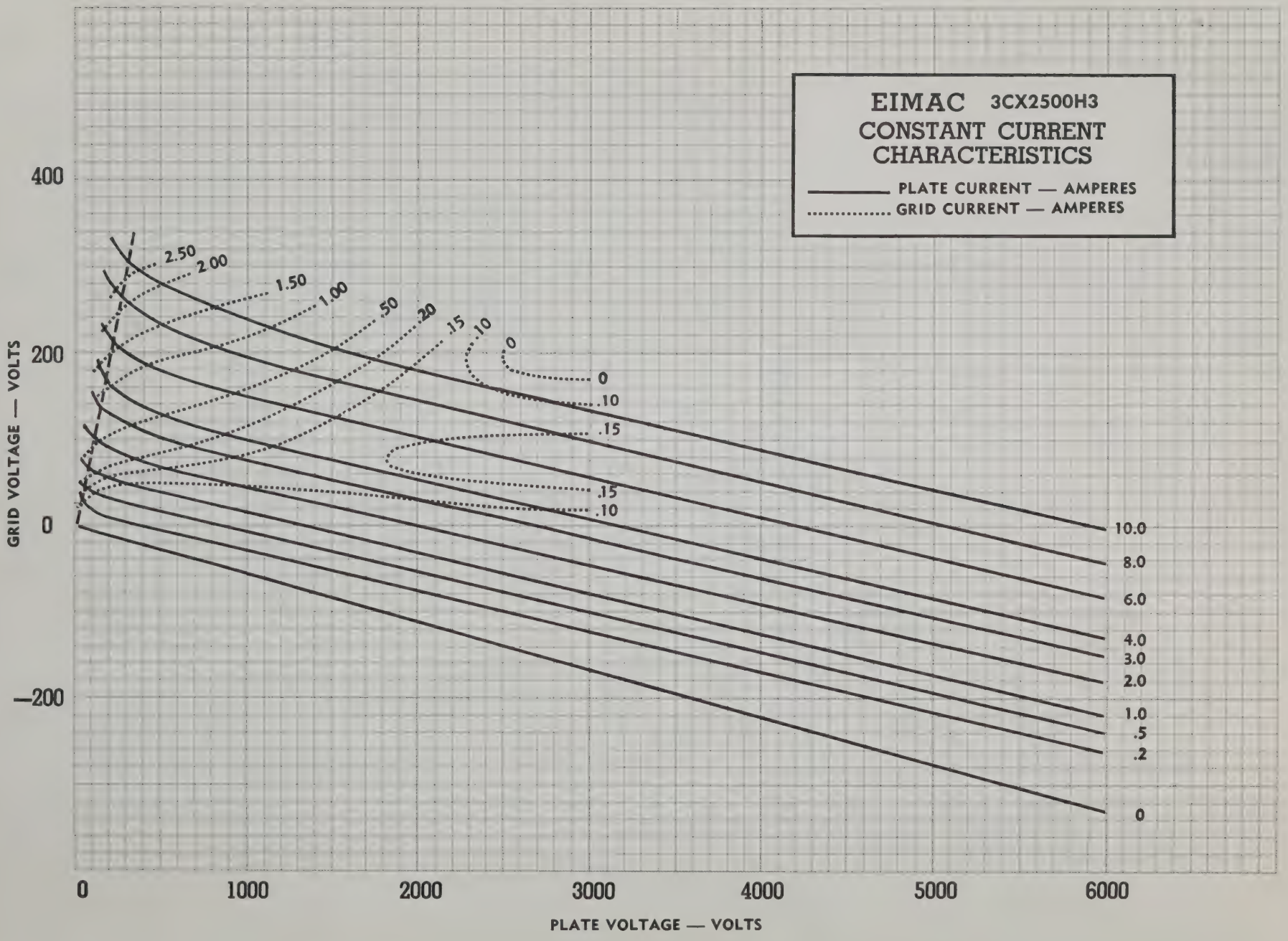


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	8.000	9.000	
B	4.093	4.156	
C	3.875	4.250	
D	2.937	3.062	
E	1.703	1.953	
F			.125
G	.781	.843	
H	.687	.812	
J	1.000	1.125	
K	8.937	9.437	
L	7.937	8.437	
M			.390
N	4.230	4.250	
P	3.855	3.885	
R			.250
S	29°	31°	

NOTES:

1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. THERE ARE 12 HOLES IN GRID FLANGE.
3. GRID FLANGE AND FILAMENT LEADS ARE TO BE ORIENTED AS SHOWN


EIMAC 3CX2500H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS

EIMAC

A Division of Varian Associates

25T

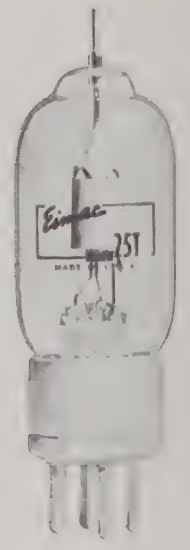
MEDIUM-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 25T is a medium-mu, power triode having a maximum plate dissipation of 25 watts and is intended for use as an amplifier, oscillator or modulator. It can be used at its maximum ratings at frequencies as high as 60 Mc.

Cooling of the 25T is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation and by means of air convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	6.3 volts
Current	3.0 amperes
Amplification Factor (Average)	24
Direct Interelectrode Capacitances (Average)	
Grid-Plate	1.5 $\mu\mu$f
Grid-Filament	2.2 $\mu\mu$f
Plate-Filament	0.2 $\mu\mu$f
Transconductance (i_b=25 ma., E_b=1000 v.)	2500 μmhos
Frequency for Maximum Ratings	60 Mc.

MECHANICAL

Base	Small 4-pin, RMA type A4-5
Basing (See outline drawing)	RMA type 3G
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connector:	
Plate	HR-1
Maximum Overall Dimensions:	
Length	4.38 inches
Diameter	1.44 inches
Net Weight	1.5 ounces
Shipping Weight (Average)	1.0 pound

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-B

MAXIMUM RATINGS, PER TUBE

D-C PLATE VOLTAGE	2000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	75 MAX. MA.
PLATE DISSIPATION	25 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

TYPICAL OPERATION, CLASS AB_2
Sinusoidal wave, two tubes unless otherwise specified

D-C Plate Voltage	750	1000	1250	Volts
D-C Grid Voltage (approx.)*	—20	—30	—42	Volts
Zero-Signal D-C Plate Current	43	32	24	Ma.
Max-Signal D-C Plate Current	127	127	130	Ma.
Effective Load, Plate-to-Plate	12,000	17,000	21,400	Ohms
Peak A-F Grid Input Voltage (per tube)	110	120	135	Volts
Max-Signal Peak Driving Power	5.5	6.0	6.8	Watts
Max-Signal Nominal Driving Power (approx.)	2.8	3.0	3.4	Watts
Max-Signal Plate Power Output	60	85	112	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1600 MAX. VOLTS
D-C PLATE CURRENT	60 MAX. MA.
PLATE DISSIPATION	17 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1000	1250	1600	Volts
D-C Plate Current	60	60	53	Ma.
D-C Grid Voltage	—120	—140	—170	Volts
D-C Grid Current	14	13	11	Ma.
Peak R-F Grid Input Voltage	235	255	280	Volts
Driving Power	3.3	3.3	3.1	Watts
Grid Dissipation	1.6	1.5	1.2	Watts
Plate Power Input	60	75	85	Watts
Plate Dissipation	13	15	17	Watts
Plate Power Output	47	60	68	Watts

The above figures show actual measured tube performance and do not allow for variations in circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS

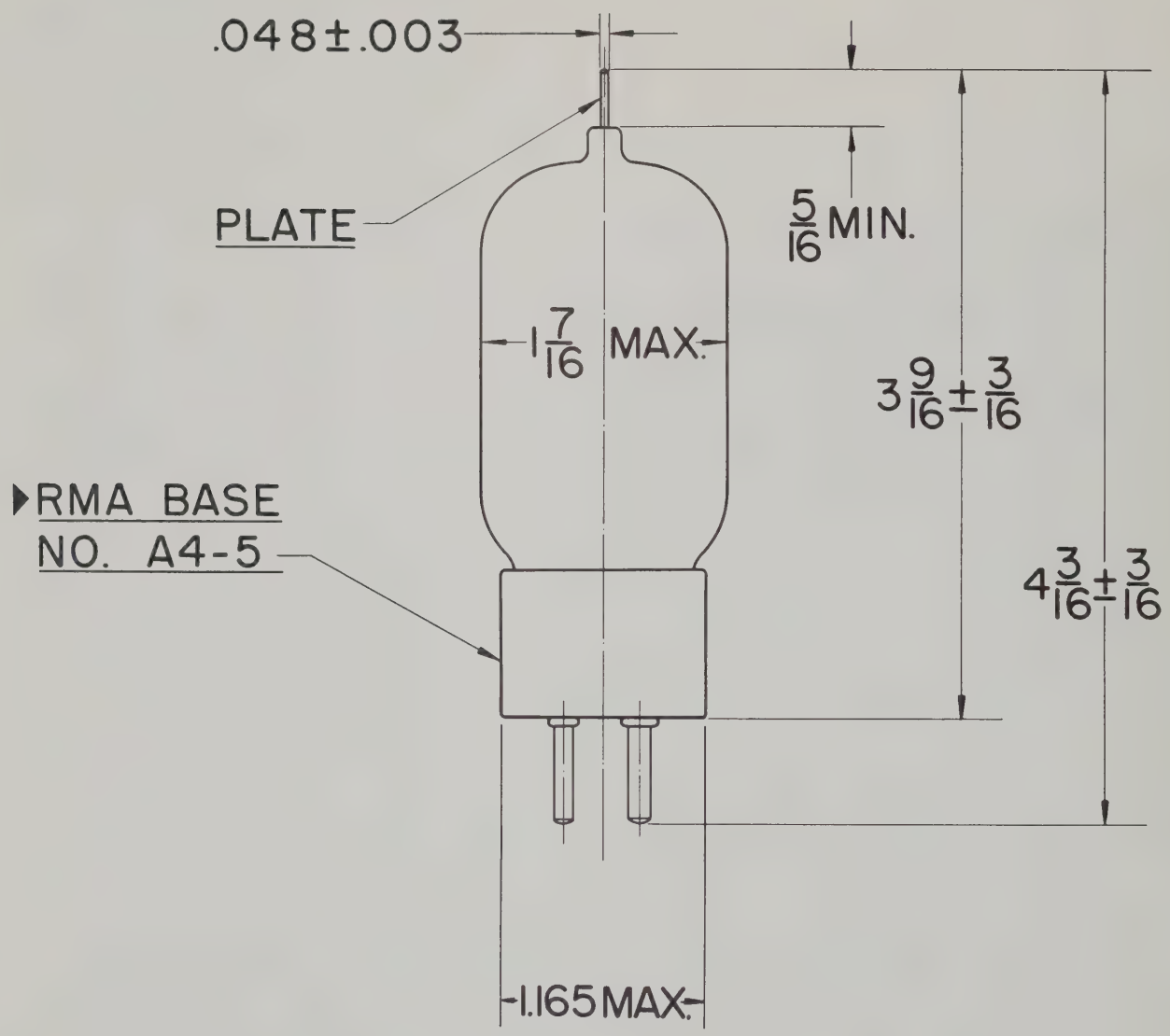
D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C PLATE CURRENT	75 MAX. MA.
PLATE DISSIPATION	25 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

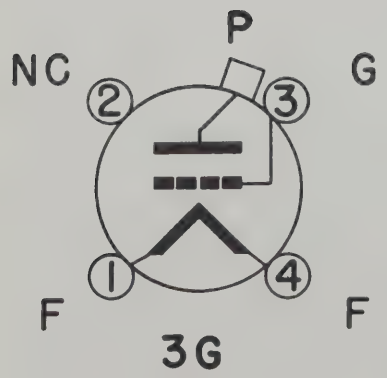
TYPICAL OPERATION

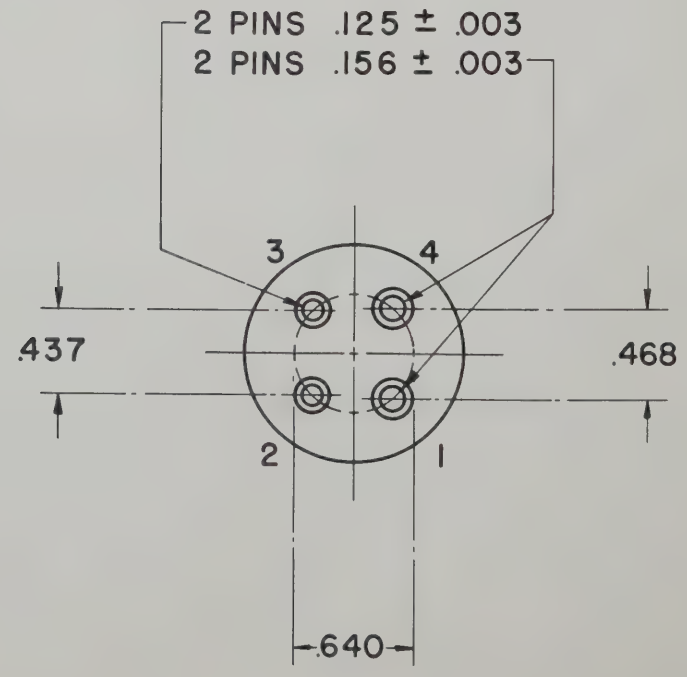
D-C Plate Voltage	1000	1500	2000	Volts
D-C Plate Current	72	67	63	Ma.
D-C Grid Voltage	—70	—95	—130	Volts
D-C Grid Current	9	13	18	Ma.
Peak R-F Grid Input Voltage	170	195	245	Volts
Driving Power	1.3	2.2	4.0	Watts
Grid Dissipation	.9	1.3	2.1	Watts
Plate Power Input	72	100	125	Watts
Plate Dissipation	25	25	25	Watts
Plate Power Output	47	75	100	Watts

The above figures show actual measured tube performance and do not allow for variations in circuit losses.

(Revised 12-15-65) Copyright 1951, 1965 by Varian Associates


.048±.003
PLATE
5/16 MIN.
1 7/16 MAX.
3 9/16 ± 3/16
4 3/16 ± 3/16
▶RMA BASE
NO. A4-5
1.165 MAX.

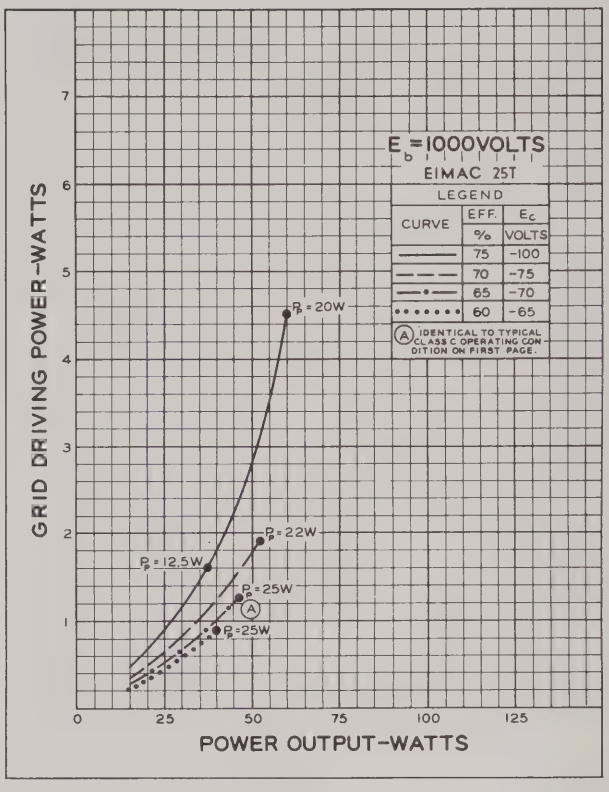

P
NC
G
2
3
1
4
F
F
3G

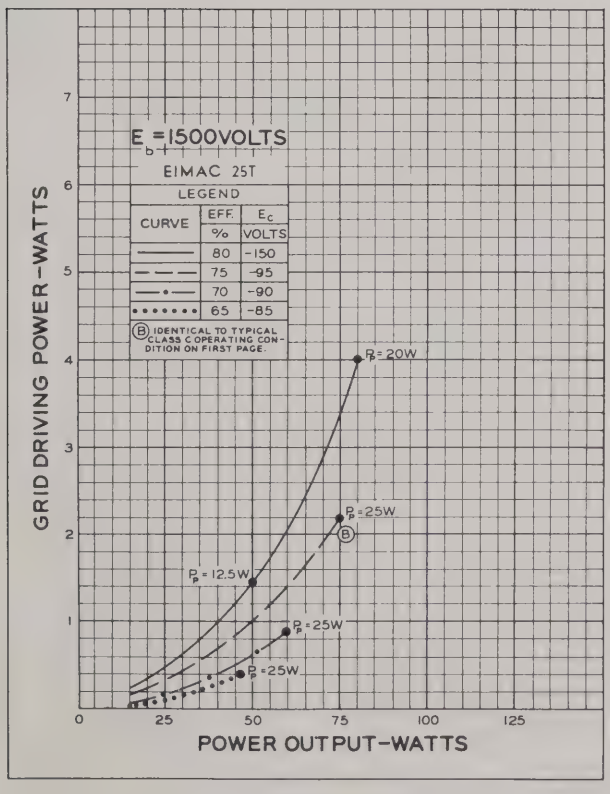

2 PINS .125 ± .003
2 PINS .156 ± .003
3
4
.437
.468
2
1
.640

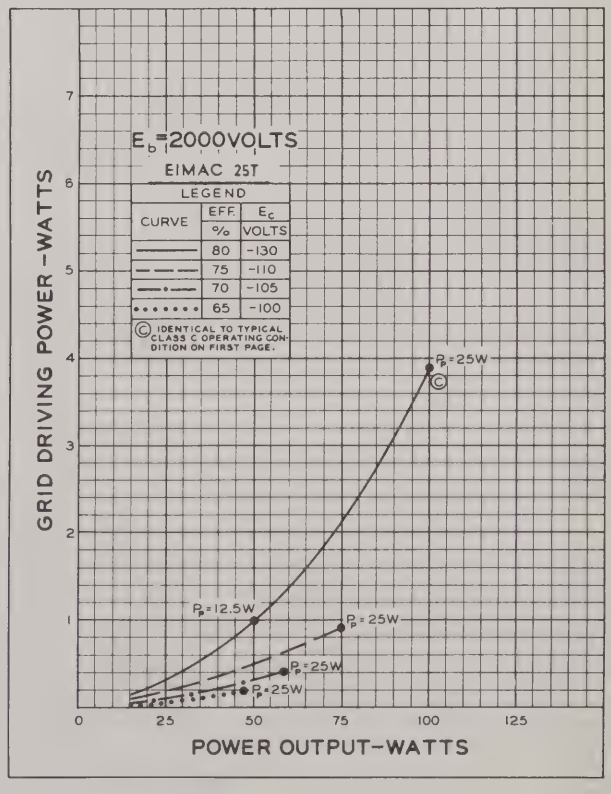
DRIVING POWER vs. POWER OUTPUT

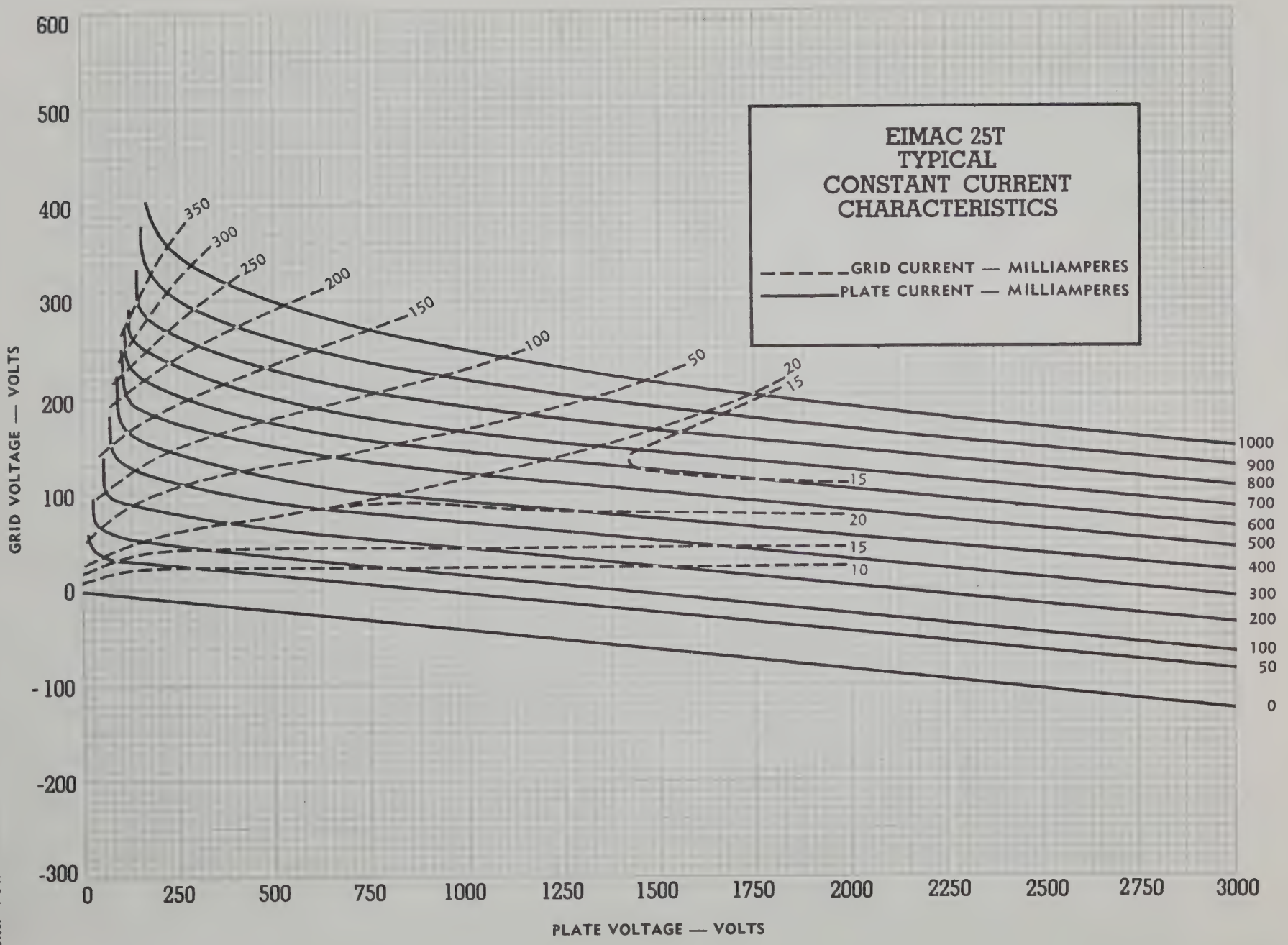
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.









Printed in U.S.A. 69010

304TL

LOW-MU TRIODE

•

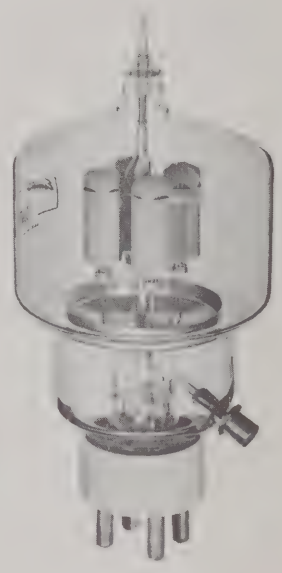
MODULATOR
OSCILLATOR
AMPLIFIER

EIMAC

A Division of Varian Associates

The Eimac 304TL is a low-mu, power triode having a maximum plate dissipation rating of 300 watts, and is intended for use as an amplifier, oscillator or modulator, where maximum performance can be obtained at low plate voltage. It can be used at its maximum ratings at frequencies as high as 40-Mc.

Cooling of the 304TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 or 10.0 volts
Current	25.0 or 12.5 amperes
Amplification Factor (Average)	12
Direct Interelectrode Capacitances (Average)	
Grid-Plate	8.6 $\mu\mu$f
Grid-Filament	12.1 $\mu\mu$f
Plate-Filament	.8 $\mu\mu$f
Transconductance (i_b=1.0 amp., E_b=3000 v, e_c= —175v.)	16,700 μmhos
Frequency for Maximum Ratings	40 Mc.

MECHANICAL

Base	Special 4 pin, No. 5000B
Socket	Johnson No. 124-213 or Equivalent
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connectors:	
Plate	HR-7
Grid	HR-6
Maximum Overall Dimensions:	
Length	7.625 inches
Diameter	3.563 inches
Net weight	9 ounces
Shipping weight (Average)	2 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	900 MAX. MA.
PLATE DISSIPATION, PER TUBE	300 MAX. WATTS

TYPICAL OPERATION, CLASS AB$_1$

D-C Plate Voltage	1500	2000	2500	3000	Volts
D-C Grid Voltage (approx.)*	—118	—170	—230	—290	Volts
Zero-Signal D-C Plate Current	270	200	160	130	Ma.
Max-Signal D-C Plate Current	572	546	483	444	Ma.
Effective Load, Plate-to-Plate	2540	5300	8500	12,000	Ohms
Peak A-F Grid Input Voltage (per tube)	118	170	230	290	Volts
Max-Signal Peak Driving Power	0	0	0	0	Watts
Max-Signal Plate Power Output	256	490	610	730	Watts

*Adjust to give stated zero-signal plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION, CLASS AB$_2$

D-C Plate Voltage	1500	2000	2500	3000	Volts
D-C Grid Voltage (approx.)*	—118	—170	—230	—290	Volts
Zero-Signal D-C Plate Current	270	200	160	130	Ma.
Max-Signal D-C Plate Current	1140	1000	900	800	Ma.
Effective Load, Plate-to-Plate	2750	4500	6600	9100	Ohms
Peak A-F Grid Input Voltage (per tube)	245	290	340	390	Volts
Max-Signal Peak Driving Power	78	87	95	110	Watts
Max-Signal Nominal Driving Power (approx.)	39	44	48	55	Watts
Max-Signal Plate Power Output	1100	1400	1650	1800	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C PLATE CURRENT	700 MAX. MA.
PLATE DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

TYPICAL OPERATION (Power input limited to 500 and 1000 watts)*

D-C Plate Voltage	2000	2000	2500	2500	Volts
D-C Plate Current	250	500	200	400	Ma.
Total Bias Voltage	—500	—500	—525	—550	Volts
Fixed Bias Voltage	—410	—275	—300	—300	Volts
Grid Resistor	3000	3000	12,500	5000	Ohms
D-C Grid Current	30	75	18	50	Ma.
Peak R-F Grid Input Voltage	615	690	620	715	Volts
Driving Power	18	52	11	36	Watts
Grid Dissipation	3	15	2	9	Watts
Plate Power Input	500	1000	500	1000	Watts
Plate Dissipation	90	190	75	170	Watts
Plate Power Output	410	810	425	830	Watts

*The figures are for convenience in obtaining a 500 or 1000 Watt carrier input per tube to the modulated amplifier. The output figures do not allow for circuit losses.

TYPICAL OPERATION*

D-C Plate Voltage	1500	2000	2500	Volts
D-C Plate Current	520	525	450	Ma.
Total Bias Voltage	—370	—500	—550	Volts
Fixed Bias Voltage	—160	—260	—440	Volts
Grid Resistor	2800	3000	2000	Ohms
D-C Grid Current	75	80	55	Ma.
Peak R-F Grid Input Voltage	545	695	720	Volts
Driving Power	41	55	40	Watts
Grid Dissipation	13	15	10	Watts
Plate Power Input	780	1050	1125	Watts
Plate Dissipation	200	200	200	Watts
Power Output	580	850	925	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class C amplifier. The output figures do not allow for circuit losses.

(Effective 12-15-65) Copyright 1958-65 by Varian Associates

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

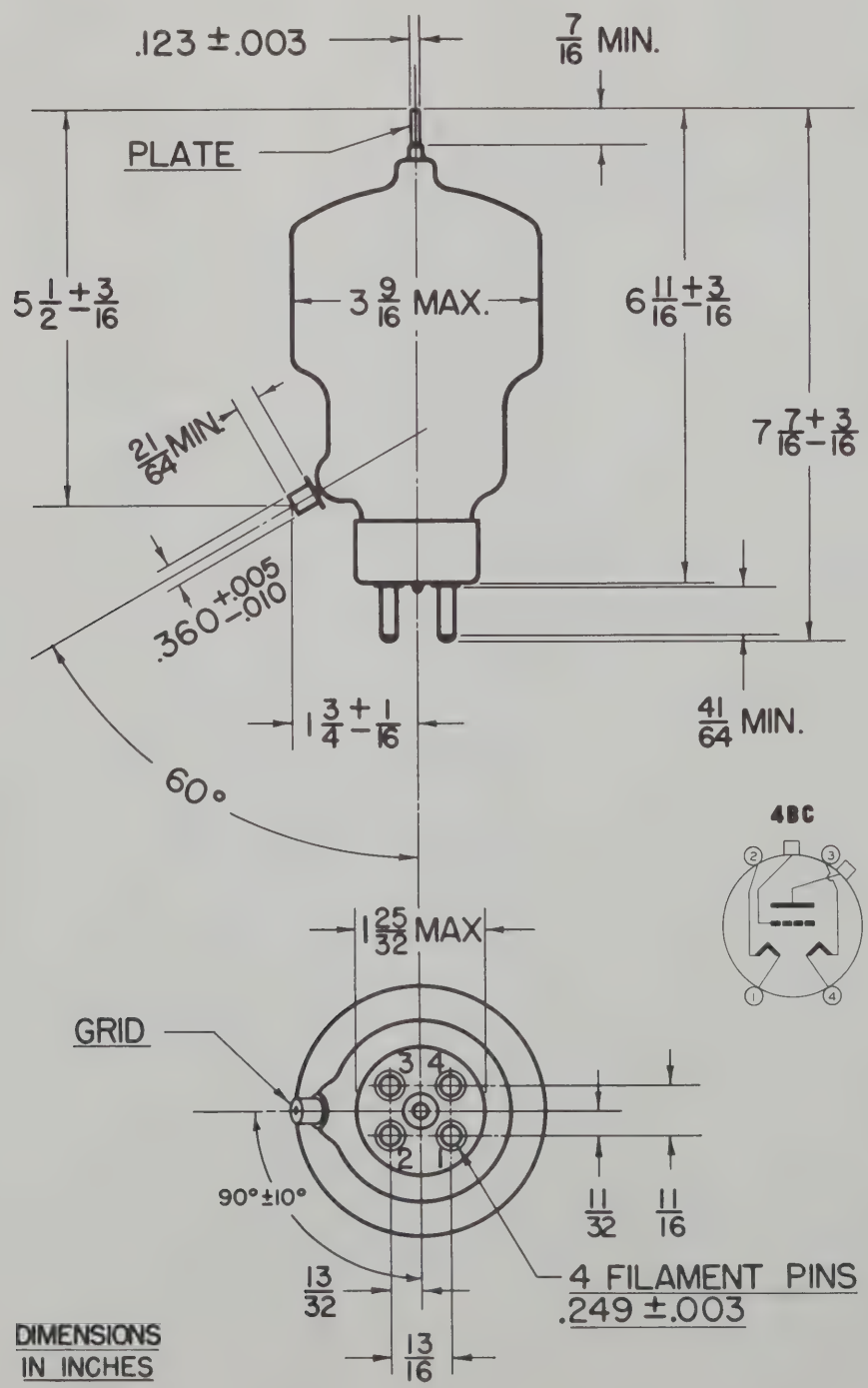
MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	900 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

TYPICAL OPERATION*

D-C Plate Voltage	1500	2000	3000 Volts
D-C Grid Voltage	—250	—300	—400 Volts
D-C Plate Current	665	600	500 Ma.
D-C Grid Current	90	85	80 Ma.
Peak R-F Grid Input Voltage	430	480	575 Volts
Driving Power (approx.)	33	36	40 Watts
Grid Dissipation	11	11	8 Watts
Plate Power Input	1000	1200	1500 Watts
Plate Dissipation	300	300	300 Watts
Plate Power Output	700	900	1200 Watts

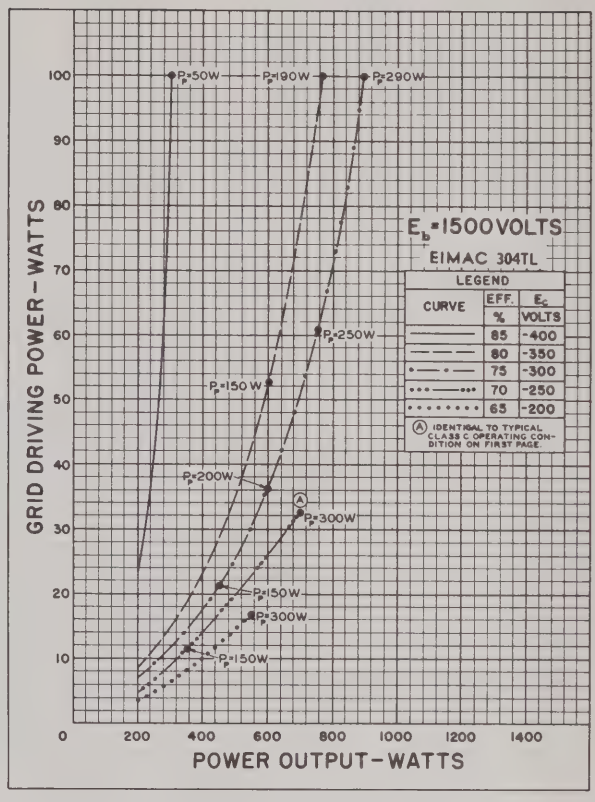
*The figures show actual measured tube performance, and do not allow for circuit losses.

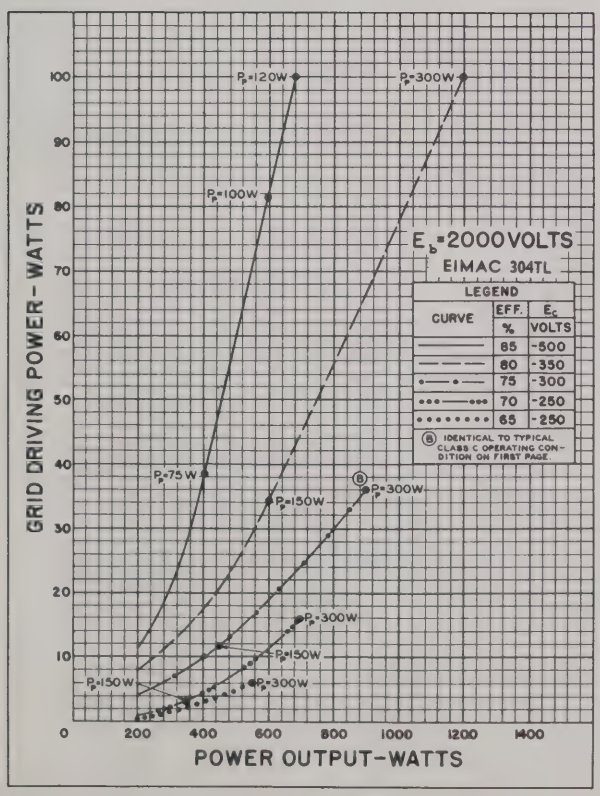


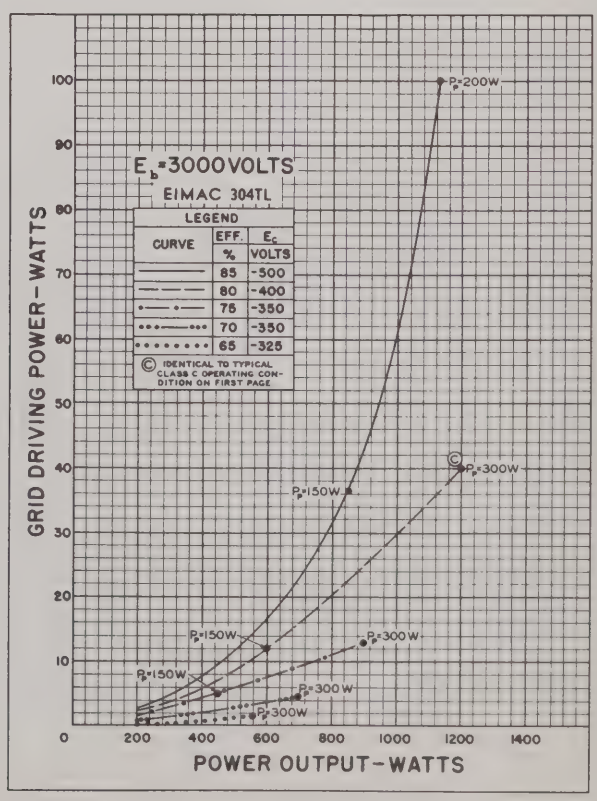
DRIVING POWER vs. POWER OUTPUT

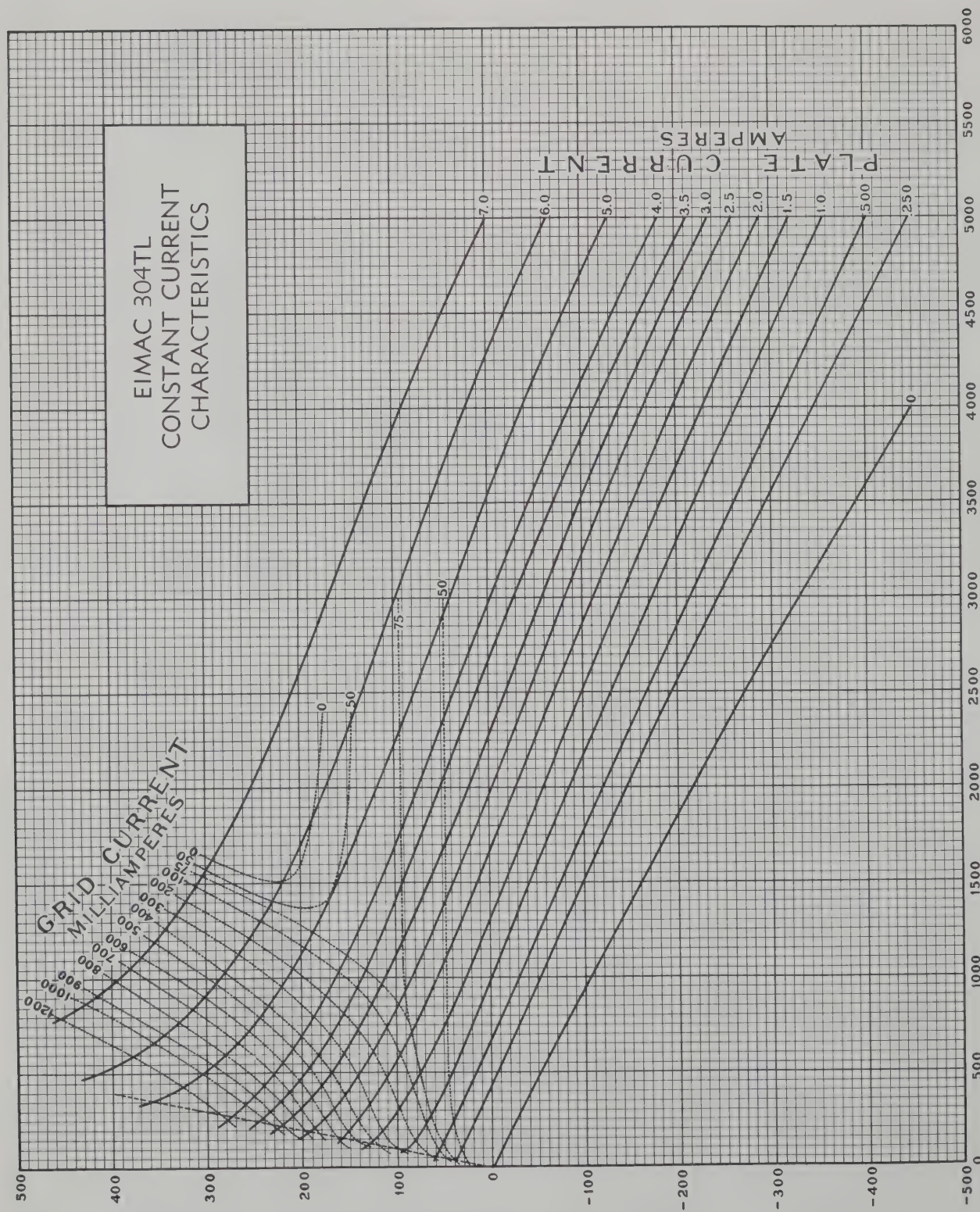
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.









Printed in U.S.A.

750TL

MEDIUM-MU TRIODE

•

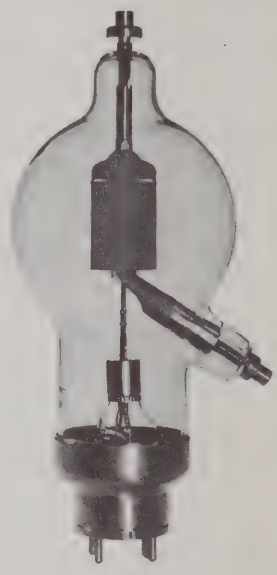
MODULATOR
OSCILLATOR
AMPLIFIER

EIMAC

A Division of Varian Associates

The Eimac 750TL is a medium-mu power triode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate dissipation rating of 750 watts and a maximum plate voltage rating of 10,000 volts at frequencies up to 40 Mc. The 750TL is cooled by air-circulation and radiation.

The 750TL in class-C r-f service will deliver up to 3000 watts plate power output with 125 watts driving power. Two 750TL's in class-AB_2 modulator service will deliver up to 3500 watts maximum-signal plate power output with 46 watts driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor	14.5		16.5	
Direct Interelectrode Capacitances:				
Grid-Plate	5.0		7.0	μμf
Grid-Filament	7.0		10.0	μμf
Plate-Filament	0.9		1.5	μμf
Transconductance (I_b=250 ma., E_b=5000 v.)	-	3500		μmhos
Frequency for Maximum Ratings	-	-	40	mc

MECHANICAL

Base	Special 4-pin
Connections	See outline drawing
Socket	Johnson type No. 124-214 or equivalent
Mounting Position	Vertical, base down or up
Cooling	Air-circulation and radiation
Recommended Plate and Grid Heat-Dissipating Connectors	Eimac HR-8
Maximum Overall Dimensions:	
Length	17.0 inches
Diameter	7.13 inches
Net Weight (Average)	2.9 pounds
Shipping Weight (Average)	13 pounds

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_2 (Sinusoidal wave)

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	10,000 MAX. VOLTS
D-C PLATE CURRENT	1000 MAX. MA
PLATE DISSIPATION	750 MAX. WATTS
GRID DISSIPATION	100 MAX. WATTS

TYPICAL OPERATION (Two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Grid Voltage[1]	—230	—320	—390	volts
Zero-Signal D-C Plate Current	250	200	166	ma.
Max-Signal D-C Plate Current	950	860	834	ma
Effective Load, Plate-to-Plate	8270	12,300	16,300	ohms
Peak A-F Grid Voltage (per tube)	490	560	650	volts
Max-Signal Driving Power*	38	28	46	watts
Max-Signal Plate Power Input	3800	4300	5000	watts
Max-Signal Plate Power Output	2300	2800	3500	watts

[1]Adjust to stated zero-signal plate current.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 40 Mc.)

D-C PLATE VOLTAGE	10,000 MAX. VOLTS
D-C PLATE CURRENT	1000 MAX. MA
PLATE DISSIPATION	750 MAX. WATTS
GRID DISSIPATION	100 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 40 Mc.)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Grid Voltage	—350	—450	—550	—700	volts
D-C Plate Current	713	625	600	625	ma
D-C Grid Current*	120	90	90	105	ma
Peak R-F Grid Voltage	805	885	985	1040	volts
Driving Power*	97	83	86	125	watts
Grid Dissipation*	55	40	38	50	watts
Plate Power Input	2140	2500	3000	3750	watts
Plate Power Output	1390	1750	2250	3000	watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

CLASS-C TELEPHONY (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 40 Mc.)

D-C PLATE VOLTAGE	8000 MAX. VOLTS
D-C PLATE CURRENT	800 MAX. MA
PLATE DISSIPATION	500 MAX. WATTS
GRID DISSIPATION	100 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 40 Mc.)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Grid Voltage	—500	—650	—800	—950	volts
D-C Plate Current	415	400	400	415	ma
D-C Grid Current*	55	60	55	60	ma
Peak R-F Grid Voltage	830	985	1150	1330	volts
Driving Power*	45	50	60	75	watts
Grid Dissipation*	15	15	16	20	watts
Plate Power Input	1250	1600	2000	2500	watts
Plate Power Output	750	1100	1500	2000	watts

*Approximate values

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION" POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

(Effective 12-15-65) Copyright 1952, 1965 by Varian Associates

APPLICATION

MECHANICAL

Mounting—The 750TL must be mounted vertically, base down or up. The plate and grid leads should be flexible. The tube must be protected from vibration and shock.

Cooling—Heat Dissipating Connectors (Eimac HR-8 or equivalent) must be used at the plate and grid terminals of the 750TL. Unobstructed circulation of air around the tube is required in sufficient quantity to prevent the seal temperatures from exceeding 225° C. Forced ventilation of compartments or equipment in which the tube is located is usually desirable. Forced movement of air across the tube seals and envelope is always beneficial, though not necessarily required.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Variations should be kept within the range of 7.5 to 7.85 volts. All four socket terminals should be used, placing two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit placed on the bias voltage which may be used with the 750TL, there is little advantage in using bias voltages in excess of those given under "Typical Operation", except in certain very specialized applications.

When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

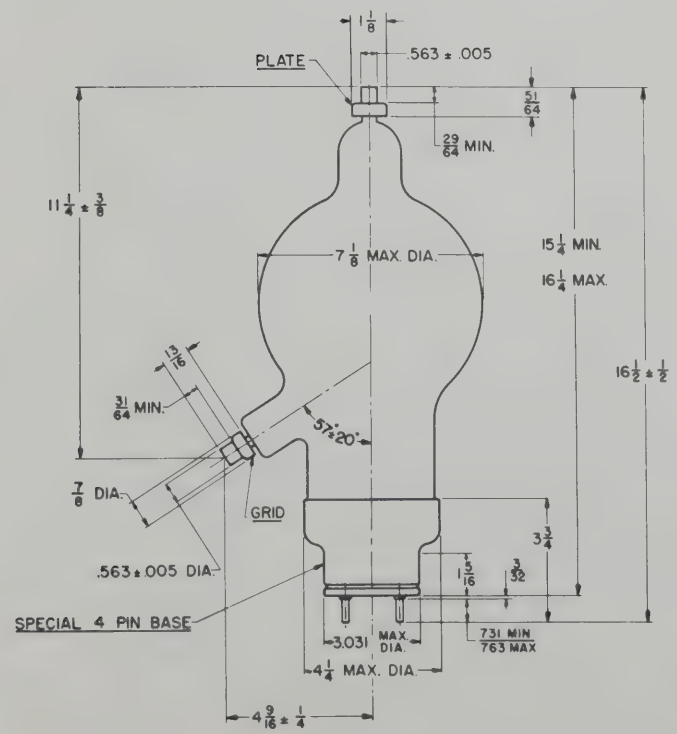
Grid Dissipation—Grid dissipation may be calculated from the following expression:

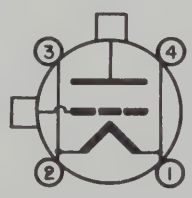
$$P_g = e_{cmp} I_c$$

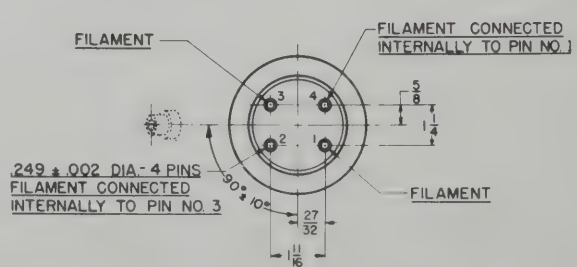
where: P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-C grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating of 100 watts under any conditions of loading.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 750TL should not be allowed to exceed the maximum rating. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.



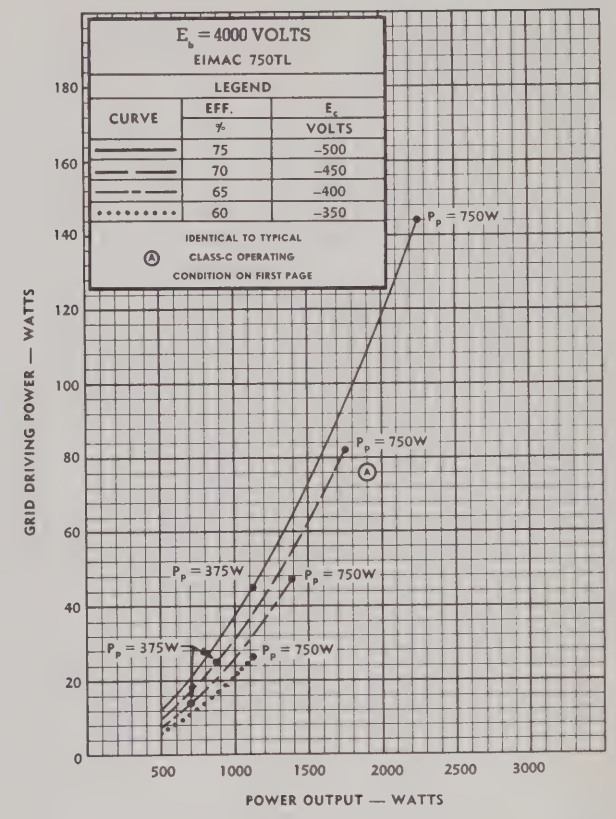


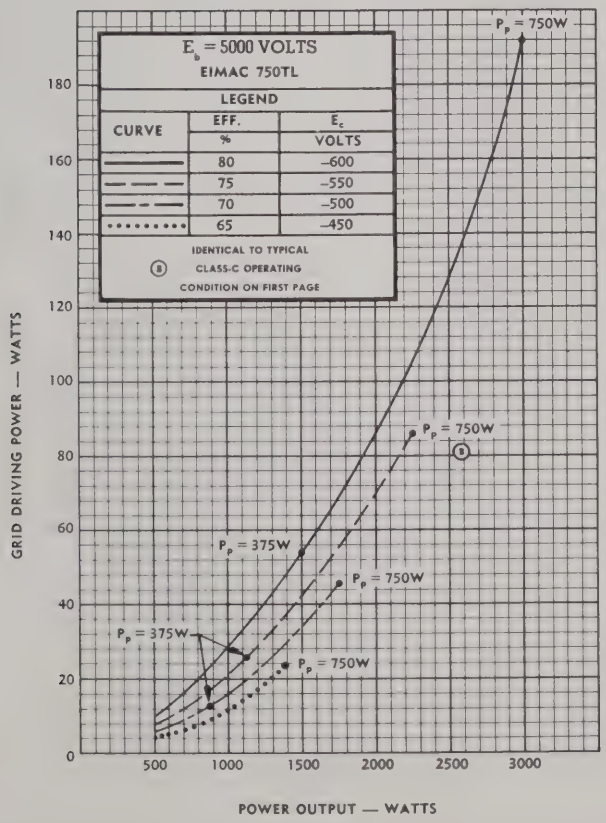


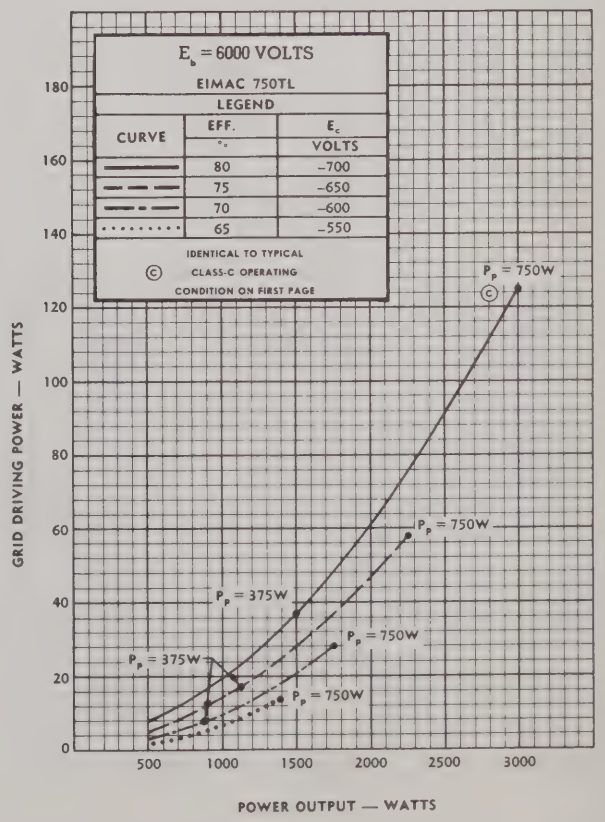
ALL DIMENSIONS IN INCHES

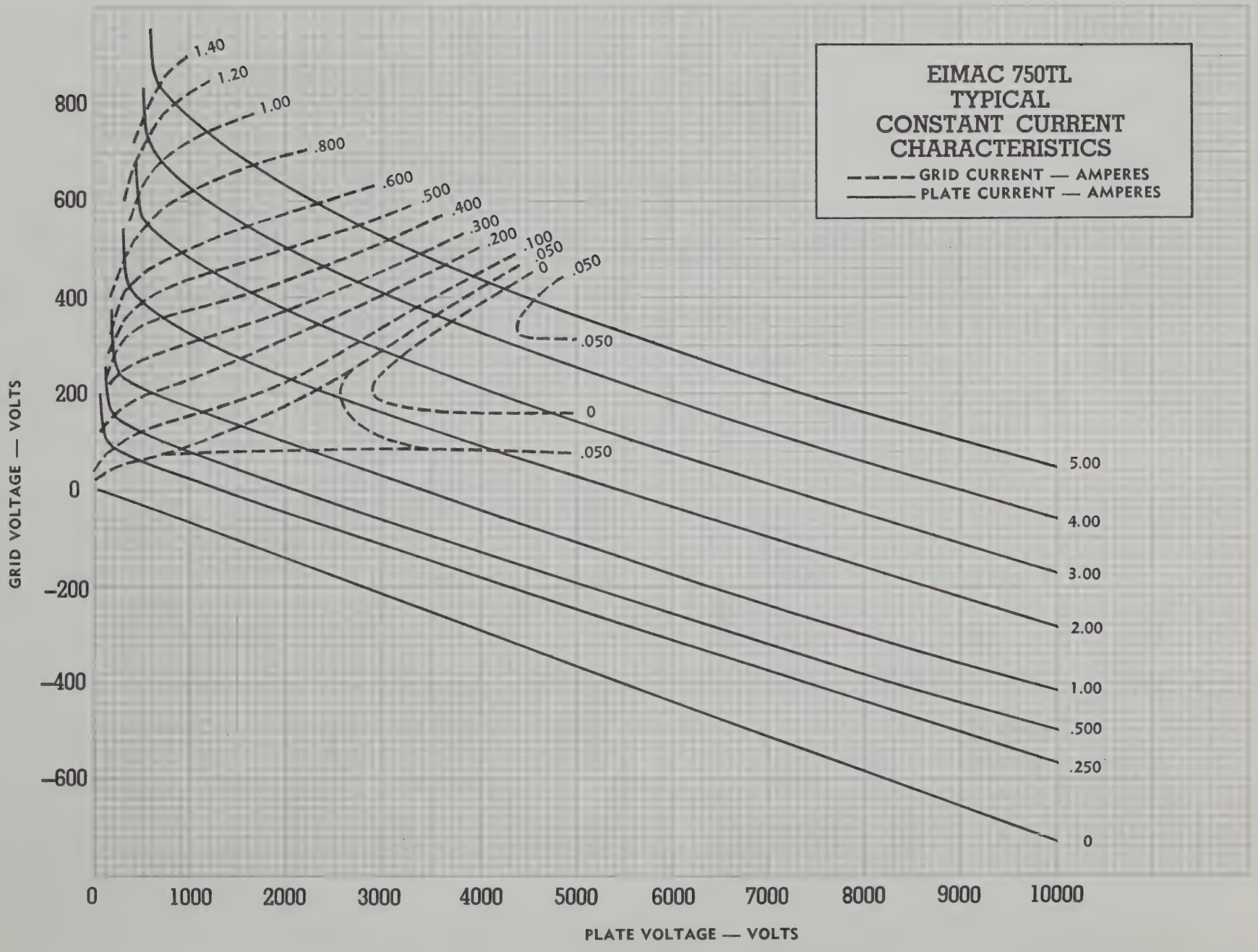
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B and C are identical to the typical Class-C operating conditions shown on the first page under 4000, 5000 and 6000 volts, respectively.









Printed in U.S.A.

EIMAC

A Division of Varian Associates

4-125A

(4D21)
RADIAL-BEAM POWER TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER



The Eimac 4-125A is a radial-beam power tetrode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate-dissipation rating of 125 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 120 Mc.

The low grid-plate capacitance of this tetrode together with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling is by radiation from the plate and by air circulation through the base and around the envelope.

The 4-125A in class-C r-f service will deliver up to 375 watts plate power output with 2.5 watts driving power. Two 4-125A's in class-B modulator service will deliver up to 400 watts maximum-signal power output with 1.2 watts nominal driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen Amplification Factor (Average)	5.9
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.05 $\mu\mu$fd
Input	10.8 $\mu\mu$fd
Output	3.1 $\mu\mu$fd
Transconductance (I_b=50 ma., E_b=2500V., E_{c2}=400V.)	2450 μmhos
Highest Frequency for Maximum Ratings	120 Mc

MECHANICAL

Base	5-pin metal shell
Basing	See outline drawing
Socket	E. F. Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.81 inches
Net Weight	6.5 ounces
Shipping Weight	1.5 pounds

(Revised 12-15-65) Copyright 1954, 1965 by Varian Associates

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	3000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage	—100	—150	—150 volts
D-C Plate Current	200	200	167 ma
D-C Screen Current	50	40	30 ma
D-C Grid Current	12	12	9 ma
Screen Dissipation	18	14	10.5 watts
Grid Dissipation	1.6	2	1.2 watts
Peak R-F Grid Input Voltage (approx.)	230	320	280 volts
Driving Power (approx.)[3]	2.8	3.8	2.5 watts
Plate Power Input	400	500	500 watts
Plate Dissipation	125	125	125 watts
Plate Power Output	275	375	375 watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage[2]	—90	—94	—96	volts
Zero-Signal D-C Plate Current	60	50	50	ma
Max-Signal D-C Plate Current	222	240	232	ma
Zero-Signal D-C Screen Current	—1.0	—0.5	—0.3	ma
Max-Signal D-C Screen Current	17	6.4	8.5	ma
Effective Load, Plate-to-Plate	10,200	13,400	20,300	ohms
Peak, A-F Grid Input Voltage (per tube)	90	94	96	volts
Driving Power	0	0	0	watt
Max-Signal Plate Dissipation (per tube)	87.5	125	125	watts
Max-Signal Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per ct.

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	volts
D-C Screen Voltage	350	350	volts
D-C Grid Voltage	—220	—210	volts
D-C Plate Current	150	152	ma
D-C Screen Current	33	30	ma
D-C Grid Current	10	9	ma
Screen Dissipation	11.5	10.5	watts
Grid Dissipation	1.6	1.4	watts
Peak A-F Screen Voltage, 100% Modulation	210	210	volts
Peak R-F Grid Input Voltage (approx.)	375	360	volts
Driving Power (approx.)[3]	3.8	3.3	watts
Plate Power Input	300	380	watts
Plate Dissipation	75	80	watts
Plate Power Output	225	300	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—41	—45	—43	volts
Zero-Signal D-C Plate Current	87	72	93	ma
Max-Signal D-C Plate Current	400	300	260	ma
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	34	5	6	ma
Effective Load, Plate-to-Plate	7200	13,600	22,200	ohms
Peak A-F Grid Input Voltage (per tube)	141	105	89	volts
Max-Signal Avg. Driving Power (approx.)	2.5	1.4	1	watts
Max-Signal Peak Driving Power	5.2	3.1	2.4	watts
Max-Signal Plate Dissipation (per tube)	125	125	122	watts
Max-Signal Plate Power Output	350	350	400	watts
Total Harmonic Distortion	2.5	1	2.2	per ct.

[1] Above 120 Mc. the maximum plate voltage rating depends upon frequency. See page 4.

[2] The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

[3] Driving power increases above 70 Mc. See page 4.

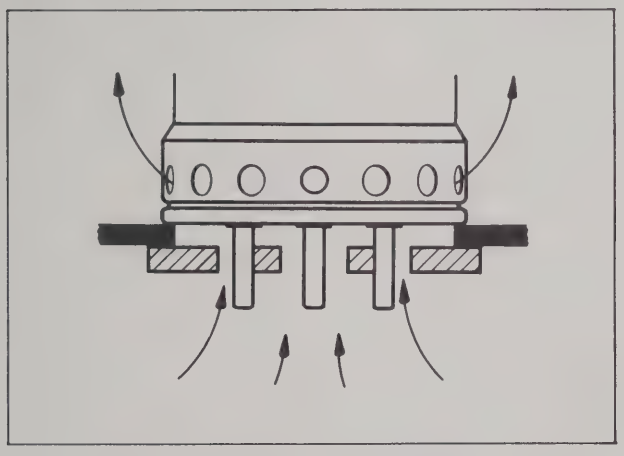
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION" POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 4-125A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-125A mounting providing base cooling, shielding and isolation of output and input compartments.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-125A should not exceed 400 volts, except for class-AB$_1$ audio operation.

Plate Voltage—The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 Mc. The maximum permissible plate voltage is less than 3000 volts above 120 Mc., as shown by the graph on page 5.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to about 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted as shown in the mounting diagram on page three provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feed-back at frequencies above 100 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest posible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 Mc. ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below about 30 Mc.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 5. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 Mc. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 Mc.

Conventional capacitance - shortened quarter - wave linear grid tank circuits having a calculated Z_0 of 160 ohms or less may be used with the 4-125A up to 175 Mc. Above 175 Mc. linear grid tank circuits employing a "capacitor"-type shortening bar, as illustrated in the diagram below, may be used. The capacitor, C_1, may consist of two silver-plated brass plates one inch square with a piece of .010 inch mica or polystyrene as insulation.

Class-C AM Telephony—The r-f circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 2.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio—Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

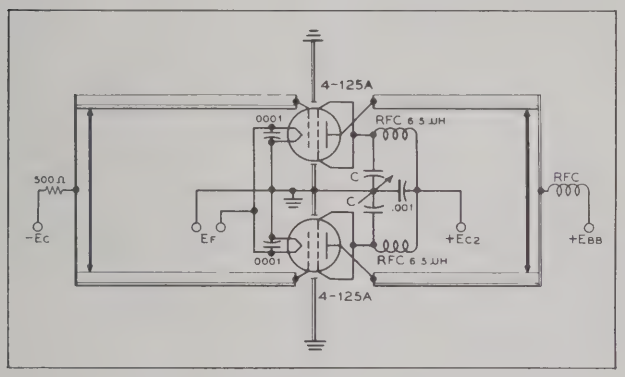
When type 4-125A tubes are used as class-AB_1 or class-AB_2 audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation", the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order

of regulation will serve. The driver plate supply makes a convenient source of screen voltage under these conditions.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.

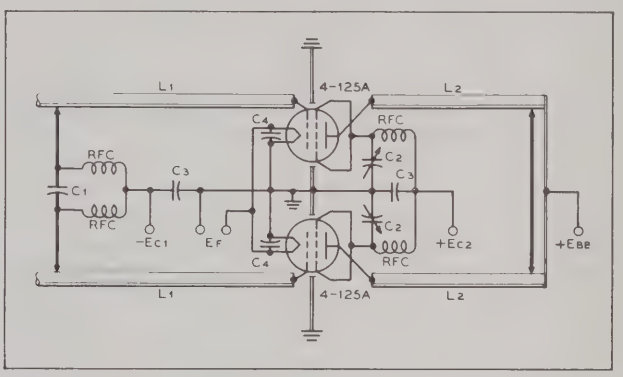
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



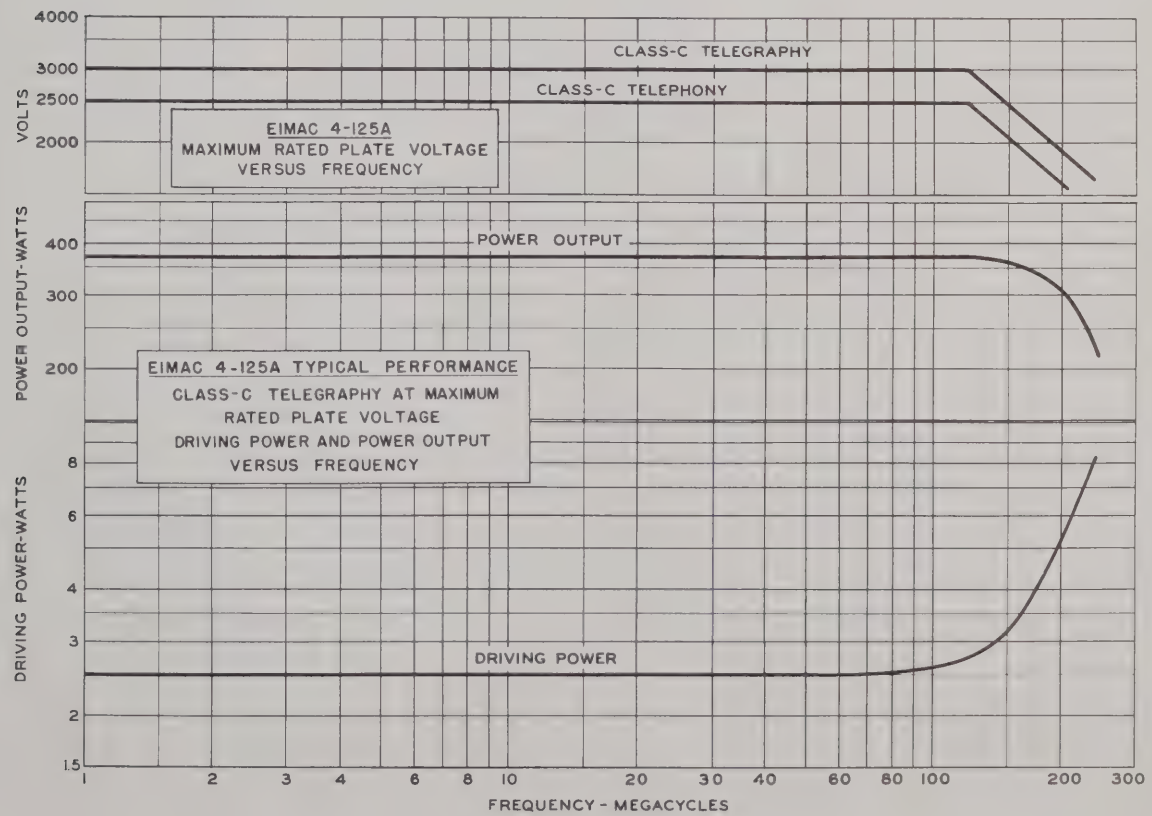
Screen-tuning neutralization circuit for use above 100 Mc. C is a small split-stator capacitor.

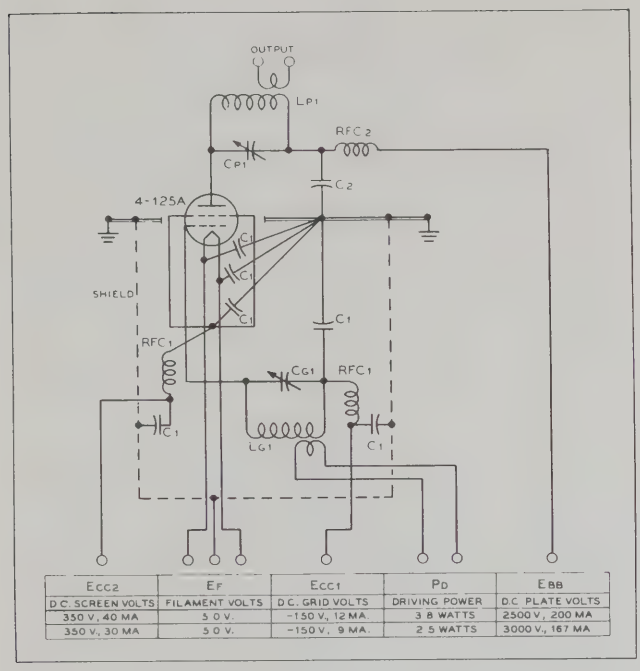
$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\ ,\ approx.$$



Typical circuit arrangement useful for frequencies above 175 Mc.

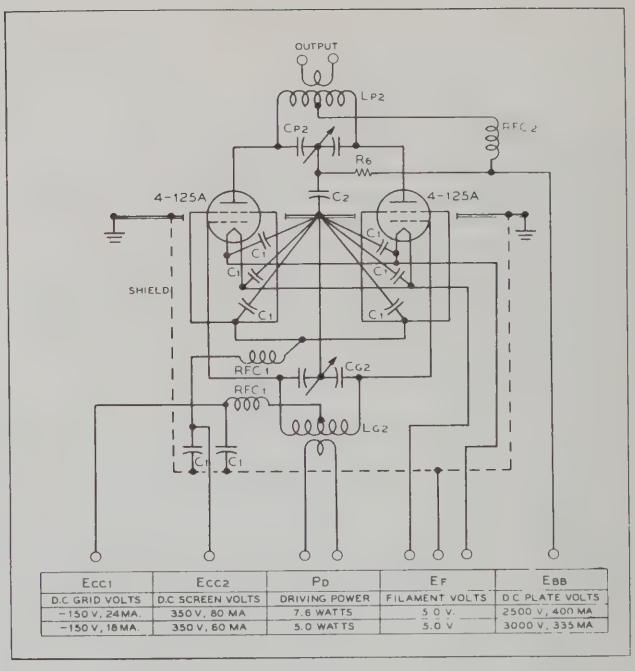
C_1—See above.
C_2—Neutralizing capacitor.
C_3—.001 μfd.
C_4—100 $\mu\mu$fd.
L_1—3/8" dia. copper spaced 1" center-to-center, 6" long.
L_2—7/8" dia. brass, silver plated, spaced 1 1/2" center-to-center, 14" long.





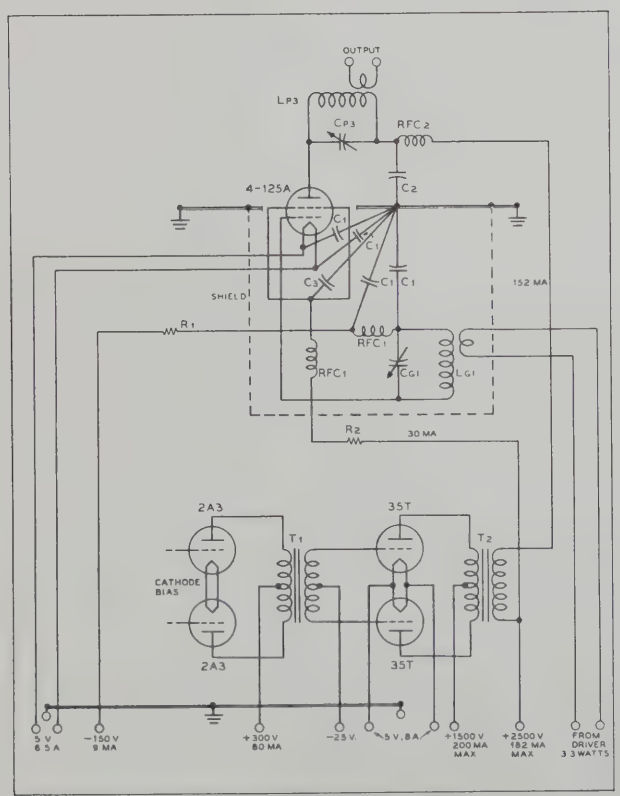
Ecc2	Ef	Ecc1	Pd	Ebb
D.C. SCREEN VOLTS	FILAMENT VOLTS	D.C. GRID VOLTS	DRIVING POWER	D.C. PLATE VOLTS
350 V., 40 MA	5.0 V.	−150 V., 12 MA.	3.8 WATTS	2500 V., 200 MA
350 V., 30 MA	5.0 V.	−150 V., 9 MA.	2.5 WATTS	3000 V., 167 MA

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 500 watts input.

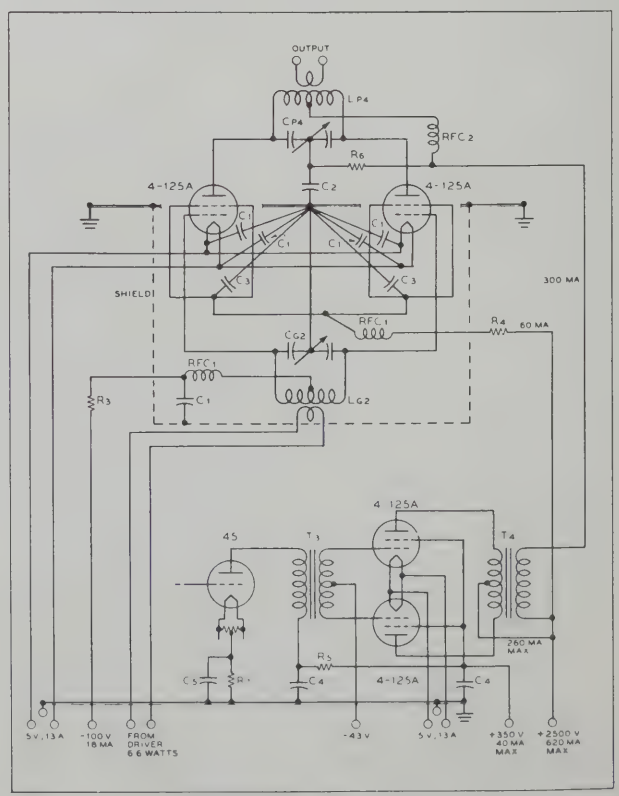


Ecc1	Ecc2	Pd	Ef	Ebb
D.C GRID VOLTS	D.C SCREEN VOLTS	DRIVING POWER	FILAMENT VOLTS	D.C PLATE VOLTS
−150 V., 24 MA.	350 V., 80 MA	7.6 WATTS	5.0 V.	2500 V., 400 MA
−150 V., 18 MA.	350 V., 60 MA	5.0 WATTS	5.0 V	3000 V., 335 MA

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 380 watts plate input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 750 watts plate input.

See opposite page for list of components.

COMPONENTS FOR TYPICAL CIRCUITS

(Diagrams, Page 6)

L_{p1} - C_{p1} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p2} - C_{p2} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p3} - C_{p3} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{p4} - C_{p4} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating freqency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — 16-ufd., 450-v. electrolytic

C_5 — 10-ufd., 25-v. electrolytic

R_1 — 7000 ohms, 5 watts

R_2 — 70,000 ohms, 100 watts

R_3 — 3500 ohms, 5 watts

R_4 — 35,000 ohms, 200 watts

R_5 — 560 ohms, 1 watt

R_6 — 25,000 ohms, 2 watts

R_7 — 1500 ohms, 5 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

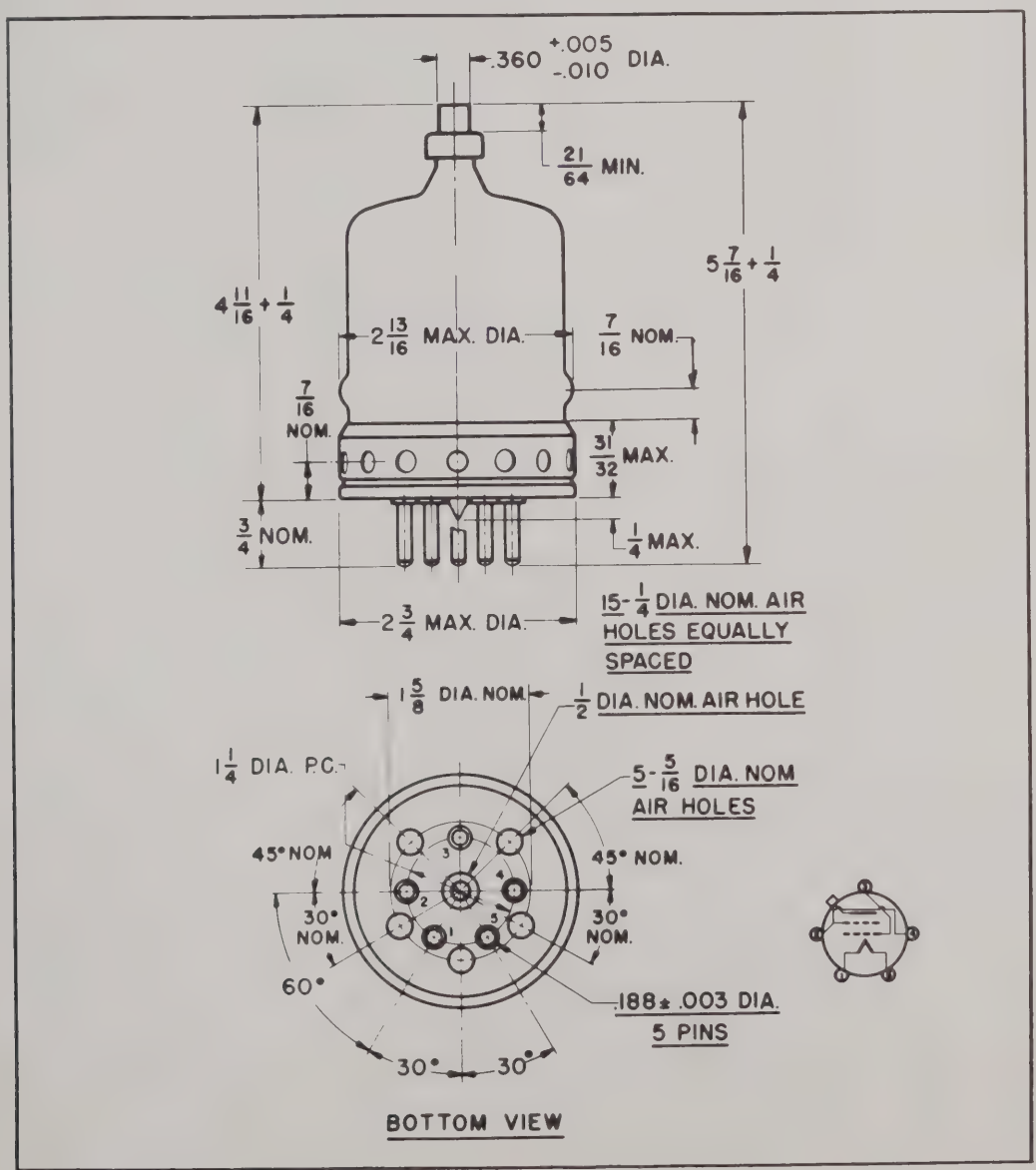
RFC_2 — 1-mhy., 500-ma. r-f choke

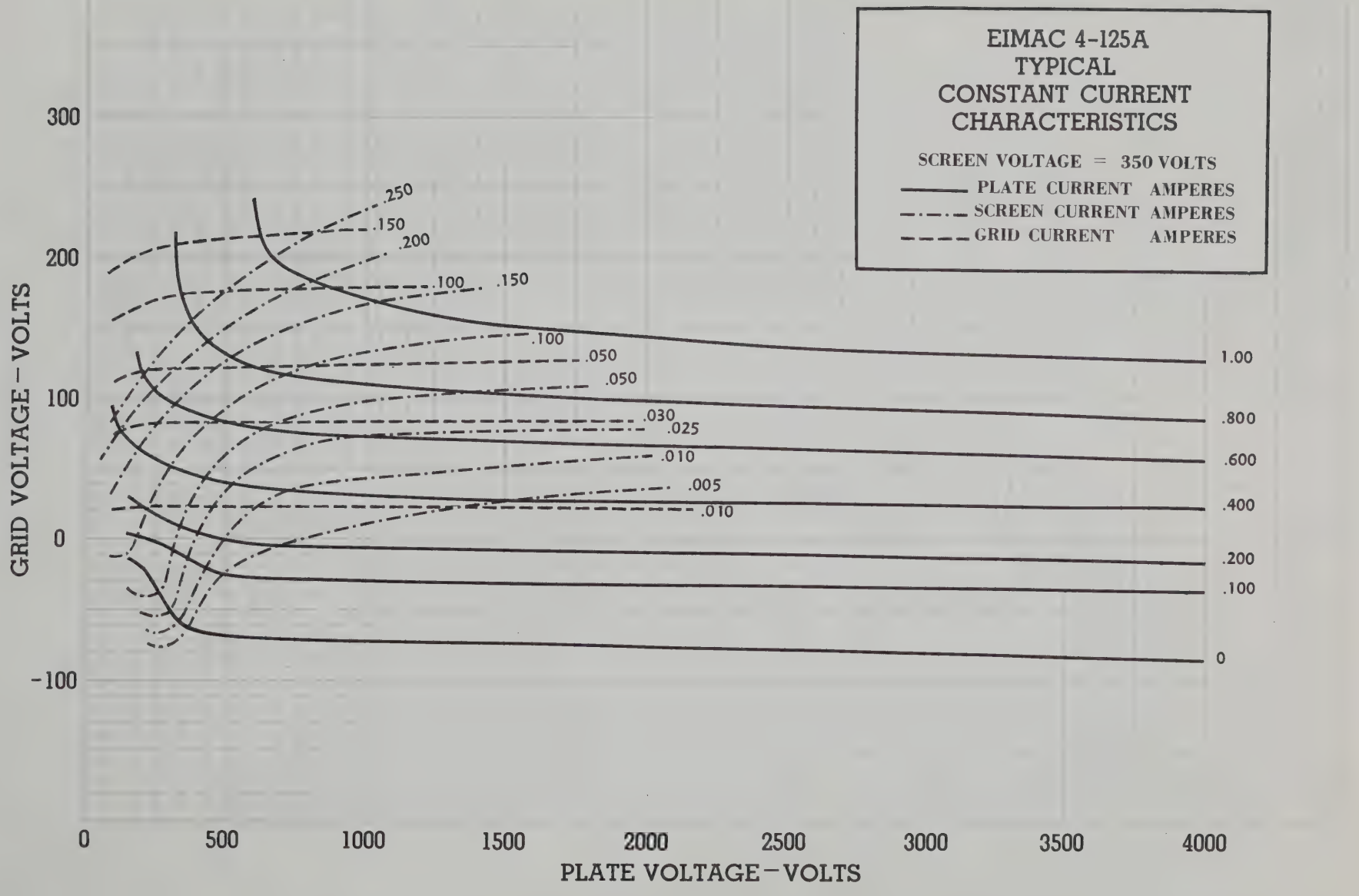
T_1 — 10-watt driver transformer; ratio pri. to ½ sec. approx. 2:1.

T_2 — 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16,200 ohms, sec. impedance = 16,500 ohms.

T_3 — 5-watt driver transformer; ratio pri. to ½ sec. approx. 1.1:1.

T_4 — 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22,200 ohms, sec. impedance = 8300 ohms.





Printed in U.S.A. 814

8438
4-400A

RADIAL-BEAM POWER TETRODE

•

MODULATOR OSCILLATOR AMPLIFIER

EIMAC

A Division of Varian Associates

The Eimac 8438/4-400A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the association circuit and driver stage.

The 8438/4-400A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an Eimac SK-400 Air-System Socket and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.†



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor (Average)	5.1
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.12 $\mu\mu$fd
Input	12.5 $\mu\mu$fd
Output	4.7 $\mu\mu$fd
Transconductance (I_b = 100ma., E_b = 2500V., E_{c2} = 500V.)	4,000 μmhos
Frequency for Maximum Ratings	110 Mc.

MECHANICAL

Base	See drawing
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Recommended Socket	Eimac SK-400 Air System Socket
Maximum Over-all Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	2.5 pounds

If an Air-System Socket is used, mounted on a 1/4 inch deck, the over-all dimensions of the system including chimney and HR-6 Heat Dissipating Plate Connector are:

Length	8.0 inches
Diameter	5.5 inches

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 Mc.)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc., one tube)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—200	—220	—220	volts
D-C Plate Current	350	350	350	ma
D-C Screen Current	46	46	40	ma
D-C Grid Current	18	19	18	ma
Screen Dissipation	23	23	20	watts
Grid Dissipation	1.8	1.9	1.8	watts
Peak R-F Grid Input Voltage	300	320	320	volts
Driving Power*	5.4	6.1	5.8	watts
Plate Power Input	875	1050	1400	watts
Plate Dissipation	235	250	300	watts
Plate Power Output	640	800	1100	watts

*Driving Power increases as frequency is increased. At 75 Mc. the driving power required is approximately 12 watts.

TYPICAL OPERATION (110 Mc., two tubes)

D-C Plate Voltage	3500	4000	volts
D-C Screen Voltage	500	500	volts
D-C Grid Voltage	—170	—170	volts
D-C Plate Current	500	540	ma
D-C Screen Current	34	31	ma
D-C Grid Current	20	20	ma
Driving Power (approx.)	20	20	watts
Plate Power Output (approx.)	1300	1600	watts
Useful Power Output	1160	1440	watts

†Guarantee applies only when the 4-400A is used as specified with adequate air in the SK-400 Air-System Socket or equivalent.

(Effective 9-1-65) © 1955-1963 by Varian Associates

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified. One tube)

MAXIMUM RATINGS (Frequencies below 75 Mc. Continuous Service)

D-C PLATE VOLTAGE	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	275 MAX. MA
PLATE DISSIPATION	270 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. Continuous Service)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	volts
D-C Plate Current	275	275	275	ma
D-C Screen Current	30	28	26	ma
D-C Grid Current	12	12	12	ma
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A-F Screen Voltage (100% modulation)	350	350	350	volts
Peak R-F Grid Input Voltage	290	290	290	volts
Driving Power	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Dissipation	170	178	195	watts
Plate Power Output	380	510	630	watts

MAXIMUM RATINGS (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	4000 MAX. VOLTS
D-C Screen Voltage	600 MAX. VOLTS
D-C Grid Voltage	—500 MAX. VOLTS
D-C Plate Current	275 MAX. MA
Plate Dissipation	270 MAX. WATTS
Screen Dissipation	35 MAX. WATTS
Grid Dissipation	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	2000	2500	3000	3650	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	—225	volts
D-C Plate Current	275	275	275	275	ma
D-C Screen Current	30	28	26	23	ma
D-C Grid Current	12	12	12	13	ma
Screen Dissipation	15	14	13	12	watts
Grid Dissipation	1.1	1.1	1.1	1.2	watts
Peak A-F Screen Voltage (100% modulation)	350	350	350	350	volts
Peak R-F Grid Input Voltage	290	290	290	315	volts
Driving Power	3.5	3.5	3.5	4.0	watts
Plate Power Input	550	688	825	1000	watts
Plate Dissipation	170	178	195	235	watts
Plate Power Output	380	510	630	765	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS AB

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	800 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION CLASS AB_1

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Screen Voltage	750	750	750	750	volts
D-C Grid Voltage (approx.)*	—130	—137	—145	—150	volts
Zero-Signal D-C Plate Current	190	160	140	120	ma
Max-Signal D-C Plate Current	635	635	610	585	ma
Zero-Signal D-C Screen Current	0	0	0	0	ma
Max-Signal D-C Screen Current	28	26	32	40	ma
Effective Load, Plate-to-Plate	6800	8900	11,500	14,500	ohms
Peak A-F Grid Input Voltage (per tube)	130	137	145	150	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	370	400	400	400	watts
Max-Signal Plate Power Output	850	1110	1330	1540	watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION CLASS AB_2

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage (approx.)*	—75	—80	—85	—90	volts
Zero-Signal D-C Plate Current	190	160	140	120	ma
Max-Signal D-C Plate Current	700	700	700	638	ma
Zero-Signal D-C Screen Current	0	0	0	0	ma
Max-Signal D-C Screen Current	50	40	38	32	ma
Effective Load, Plate-to-Plate	7200	9100	10,800	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	133	140	145	140	volts
Max-Signal Peak Driving Power	8.6	9.0	10.2	7.0	watts
Max-Signal Nominal Driving Power	4.3	4.5	5.1	3.5	watts
Max-Signal Plate Dissipation (per tube)	320	363	400	400	watts
Max-Signal Plate Power Output	1110	1375	1650	1750	watts

*Adjust for stated zero-signal plate current.

Pulse Service—For information on Pulse Service Ratings, "Application Bulletin No. 3, Pulse Service Notes", will be furnished free on request.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 4-400A must be mounted vertically, base up or base down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the Eimac SK-400 Air-System Socket. A flexible connecting strap should be provided between the Eimac HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling—Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the Eimac SK-400 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System Socket is not used, pro-

vision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—The d-c bias voltage for the 4-400A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

Screen Voltage—The d-c screen voltage for the 4-400A should not exceed 600 volts in r-f applications. In audio applications a maximum d-c screen voltage of 800 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage—The plate-supply voltage for the 4-400A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the d-c plate-supply voltage should not exceed 3200 volts, except below 30 Mc., intermittent service, where 4000 volts may be used.

Grid Dissipation—Grid dissipation for the 4-400A should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression,

$$P_g = e_{cmp} I_c$$

where P_g = Grid Dissipation
e_{cmp} = Peak positive grid to cathode voltage, and
I_c = D-c grid current

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. (For suitable peak v.t.v.m. circuits see Eimac Application Bulletin Number 6, "Vacuum Tube Ratings." This bulletin is available on request.)

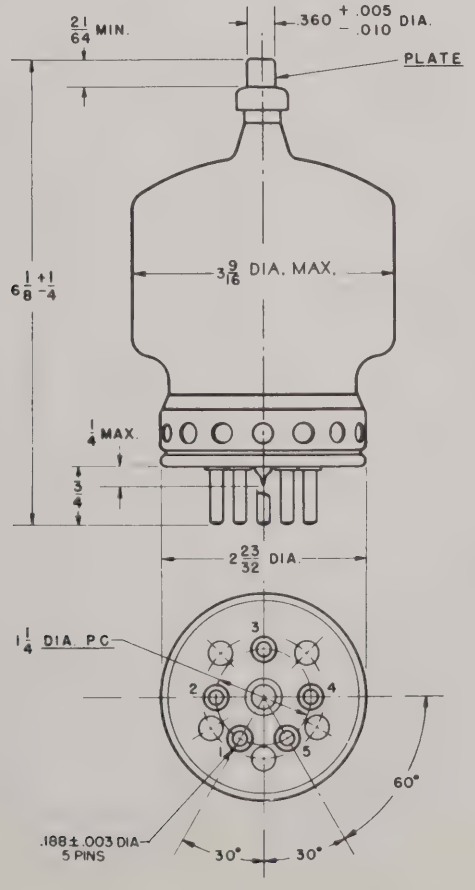
Screen Dissipation—The power dissipated by the screen of the 4-400A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

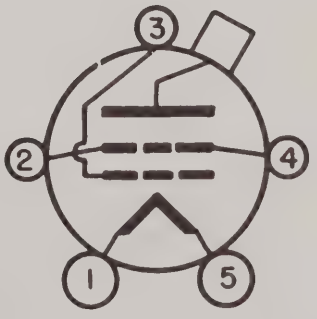
Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-400A should not be allowed to exceed 400 watts.

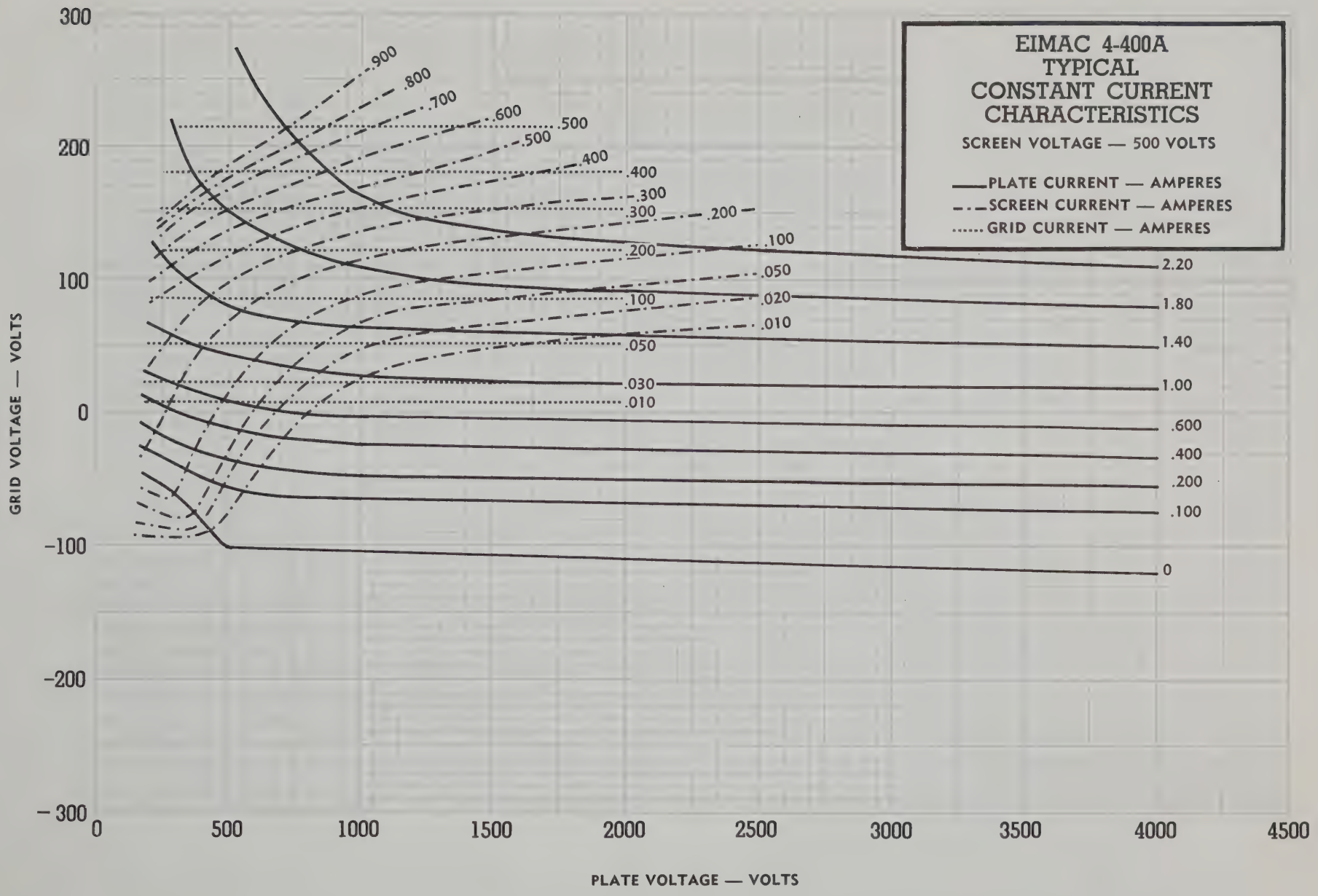
In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

GENERAL INFORMATION PERTAINING TO THE OPERATION OF THE 4-400A MAY BE FOUND IN APPLICATION BULLETIN NO. 8, "THE CARE AND FEEDING OF POWER TETRODES." THIS BULLETIN IS AVAILABLE UPON REQUEST.







Printed in U.S.A. 50847

EIMAC

A Division of Varian Associates

4CX1500B

RADIAL BEAM POWER TETRODE

JEDEC DESIGNATION

8660



The Eimac 4CX1500B is ceramic and metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 1500 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 4CX1500B especially suitable for radio-frequency and audio-frequency linear amplifier service.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance:				
(I_b=0.5 amperes, E_{c2}=225 volts)		30,000		umhos

Direct Interelectrode Capacitances, Grounded Cathode:*	Min.	Nom.	Max.	
Input	77		90	μμf
Output	11		13	μμf
Feedback			0.022	μμf
Direct Interelectrode Capacitances, Grounded Grid and Screen:*				
Input	35		41	μμf
Output	11		13	μμf
Feedback			0.005	μμf

*In Shielded Fixture

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	Eimac SK-800 Series
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (Approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	.900 MAX. AMP
PLATE DISSIPATION	1500 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
CONTROL GRID DISSIPATION	1 MAX. WATTS

*Adjust to the specified Zero-Signal Plate Current.
**The driving power specified includes the power dissipated in a 1000 ohm swamping resistor between the control grid and the cathode.
***The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies below 30 MHz)

Class AB_2, Grid Driven, Peak Envelope or Modulation Crest Conditions

DC Plate Voltage	2500	2750	2900	Volts
DC Screen Voltage	225	225	225	Volts
DC Grid Voltage*	—34	—34	—34	Volts
Zero-Signal DC Plate Current	300	300	300	mA
Single-Tone DC Plate Current	720	755	710	mA
Two-Tone DC Plate Current	530	555	542	mA
Single-Tone DC Grid Current	1.3	0.95	0.53	mA
Two-Tone DC Grid Current	0.06	0.20	0.06	mA
Single-Tone DC Screen Current	—7	—14	—15	mA
Two-Tone DC Screen Current	—11	—11	—11	mA
Peak RF Grid Voltage	46	45	41	Volts
Driving Power**	1.5	1.5	1.5	Watts
Useful Output Power	900	1100	1100	Watts
Resonant Load Impedance	1900	1900	2200	Ohms
Intermodulation Distortion Products***— 3rd order	—38	—40	—43	db
5th order	—47	—48	—47	db

(Effective 1-15-66) Copyright 1966 by Varian Associates

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	.900 MAX. AMP
PLATE DISSIPATION	1500 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	1.0 MAX. WATTS

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Sinusoidal wave, 2 tubes unless noted)

DC Plate Voltage	2000	2500	2900	Volts
DC Screen Voltage	325	325	325	Volts
DC Grid Voltage**	—60	—60	—60	Volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.68	1.69	1.69	Amps
Zero-Signal DC Screen Current*	—30	—25	—20	mA
Max.-Signal DC Screen Current*	—27	—33	—32	mA
Effective Load, Plate to Plate	1948	2715	3333	Ohms
Driving Power	0	0	0	Watts
Max.-Signal Plate Output Power	1604	2258	2774	Watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

Cooling — The maximum temperature rating for the anode core of the 4CX1500B is 250°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-to-metal seals to below 250°C. Air flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). Tube mounted in recommended socket and chimney.

	Sea Level		6000 Feet	
Plate Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1000	22	.20	26	.25
1500	39	.50	49	.63

*Since the power dissipated by the heater represents about 60 watts and since grid plus screen dissipation can, under some conditions, represent another 13 watts, allowance has been made in preparing this tabulation for an additional 73 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

Heater — The rated heater voltage for the 4CX1500B is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Intermodulation Distortion — The Radio Frequency Linear Amplifier operating conditions including the distortion data are the results of actual operation in a neutralized grid-driven amplifier. Plots of IM distortion versus power output under two-tone conditions, as a function of zero-signal plate current, are included to illustrate the effect of this parameter upon distortion. Because the 4CX1500B has very low grid interception it is possible to drive the grid positive without any adverse effects upon the distortion level or upon the driver. Class AB_2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX1500B be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.

Control-Grid Operation — The control grid dissipation rating of the 4CX1500B is 1 watt. The design features which make the 4CX1500B such an extremely linear tube also contribute to very low grid interception. It will be found that the grid will be driven into the positive grid region in the typical operation of the tube. The grid current will usually be less than 1.0 milliampere.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1500B and, under some operating conditions, indicated negative screen currents in the order of 35 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1500B is 12 watts and

the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

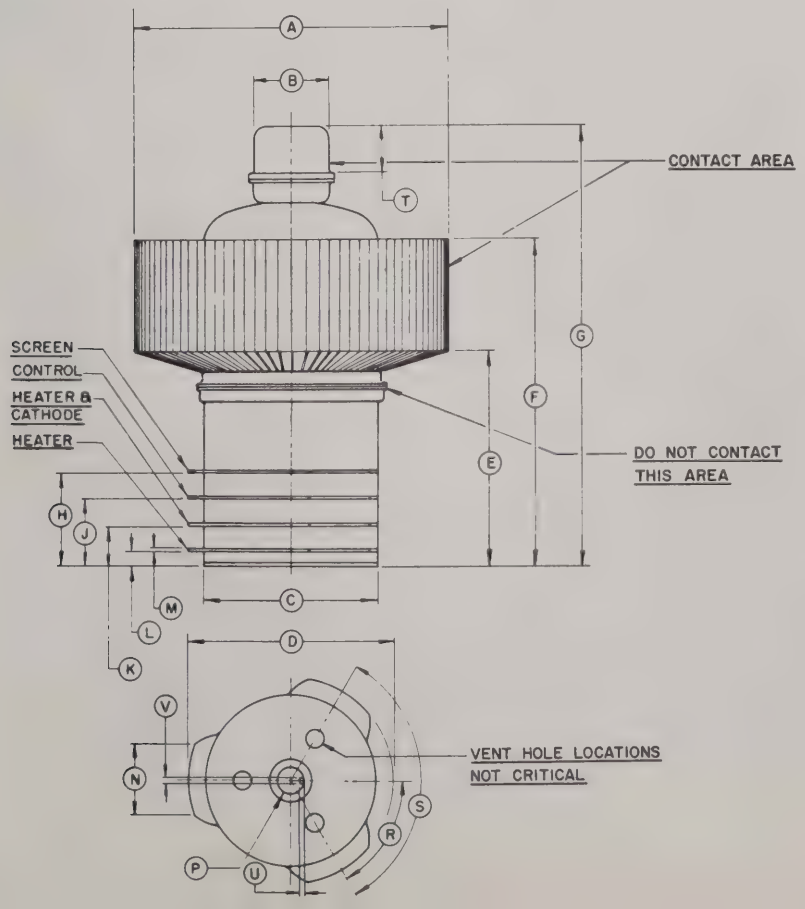
The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

Pulse Operation — The maximum rated plate dissipation power is 1500 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

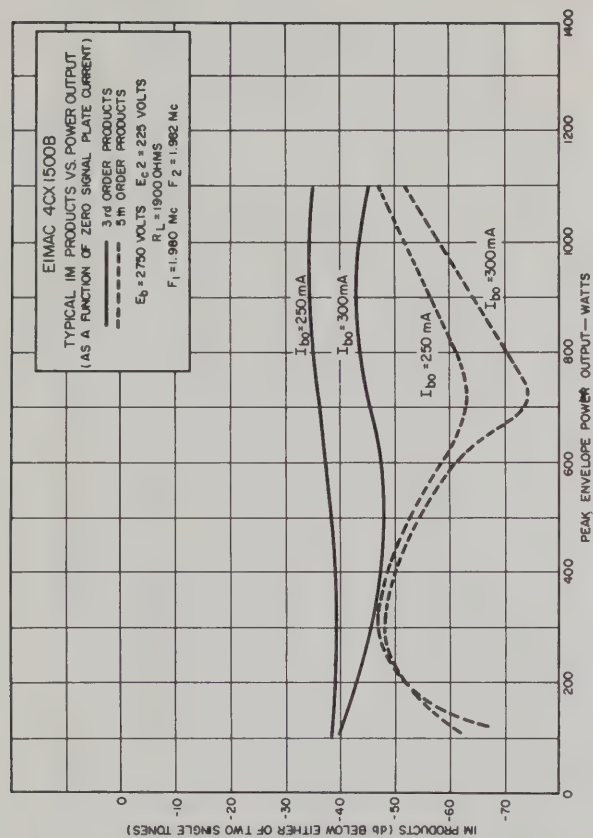
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

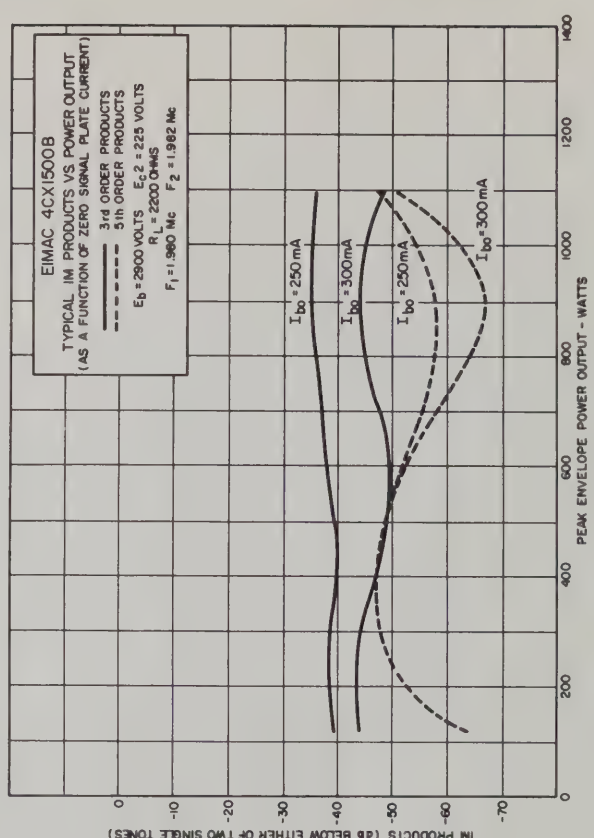
Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

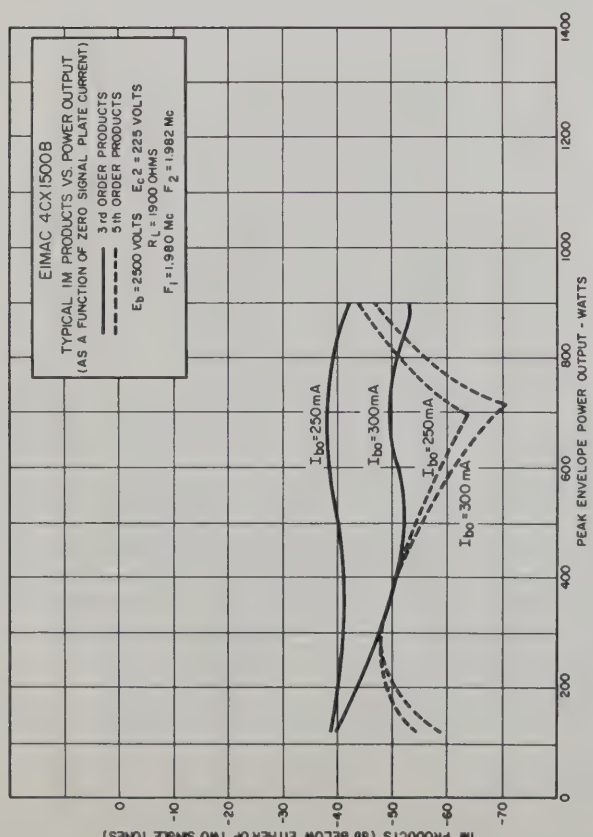
Special Applications — If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Product Manager, EIMAC Division of Varian Associates, San Carlos, California, for information and recommendations.

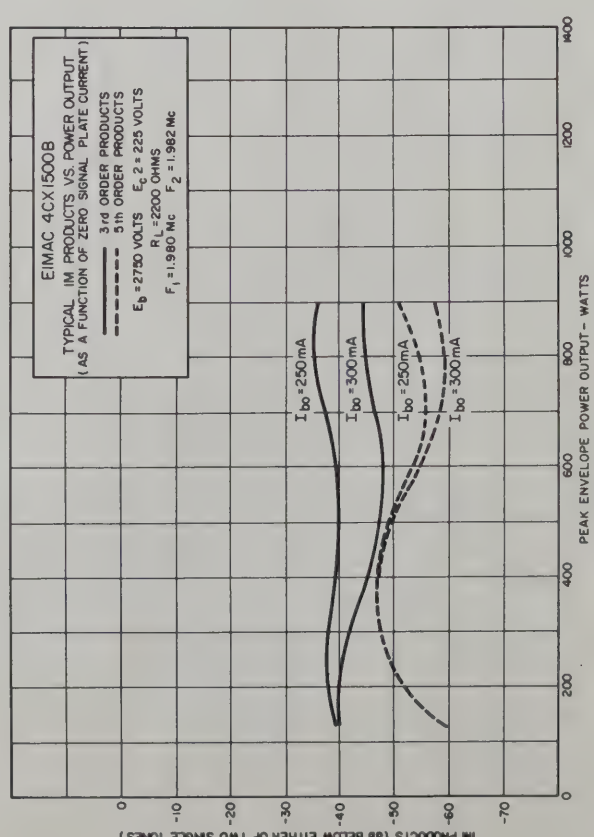


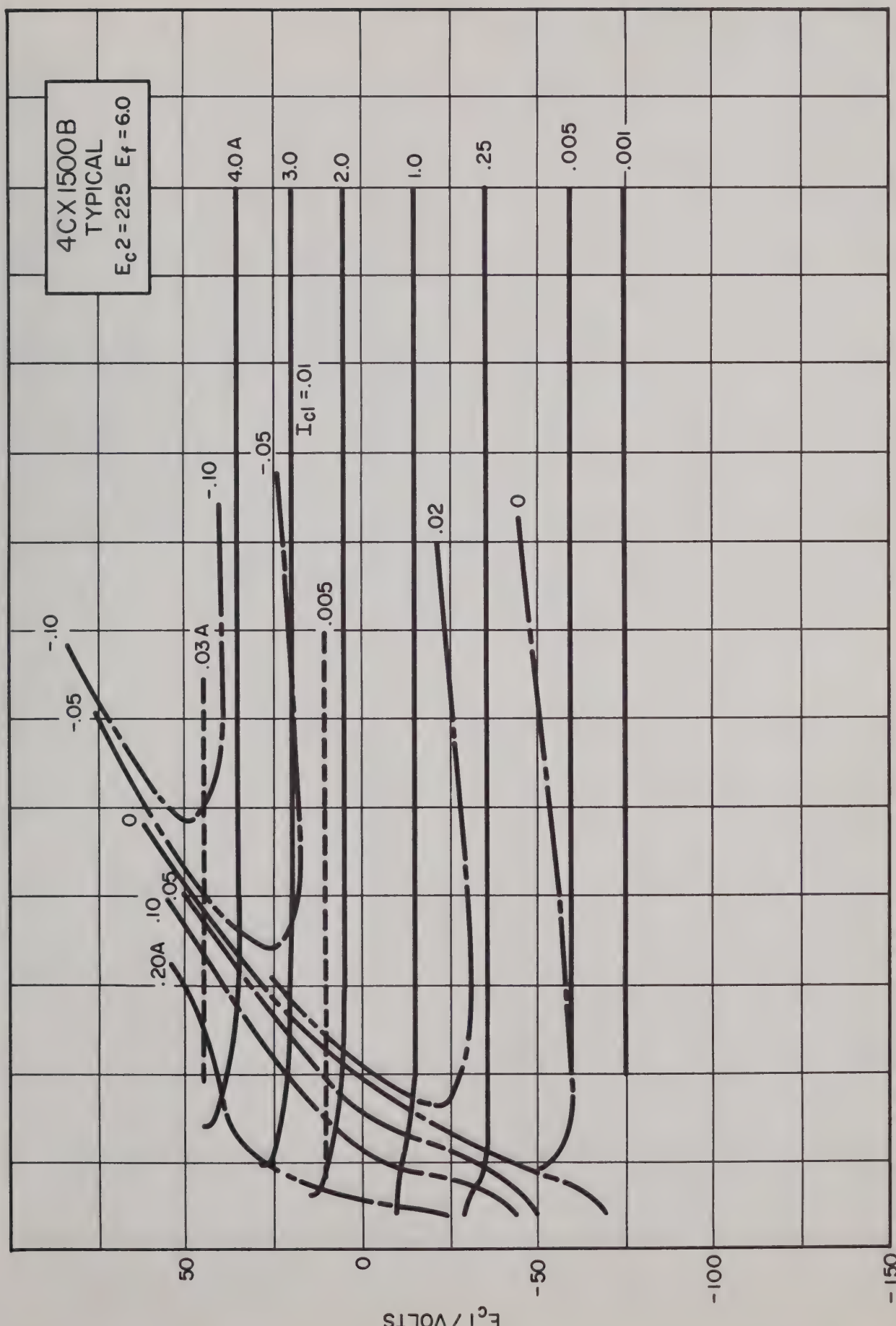
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.

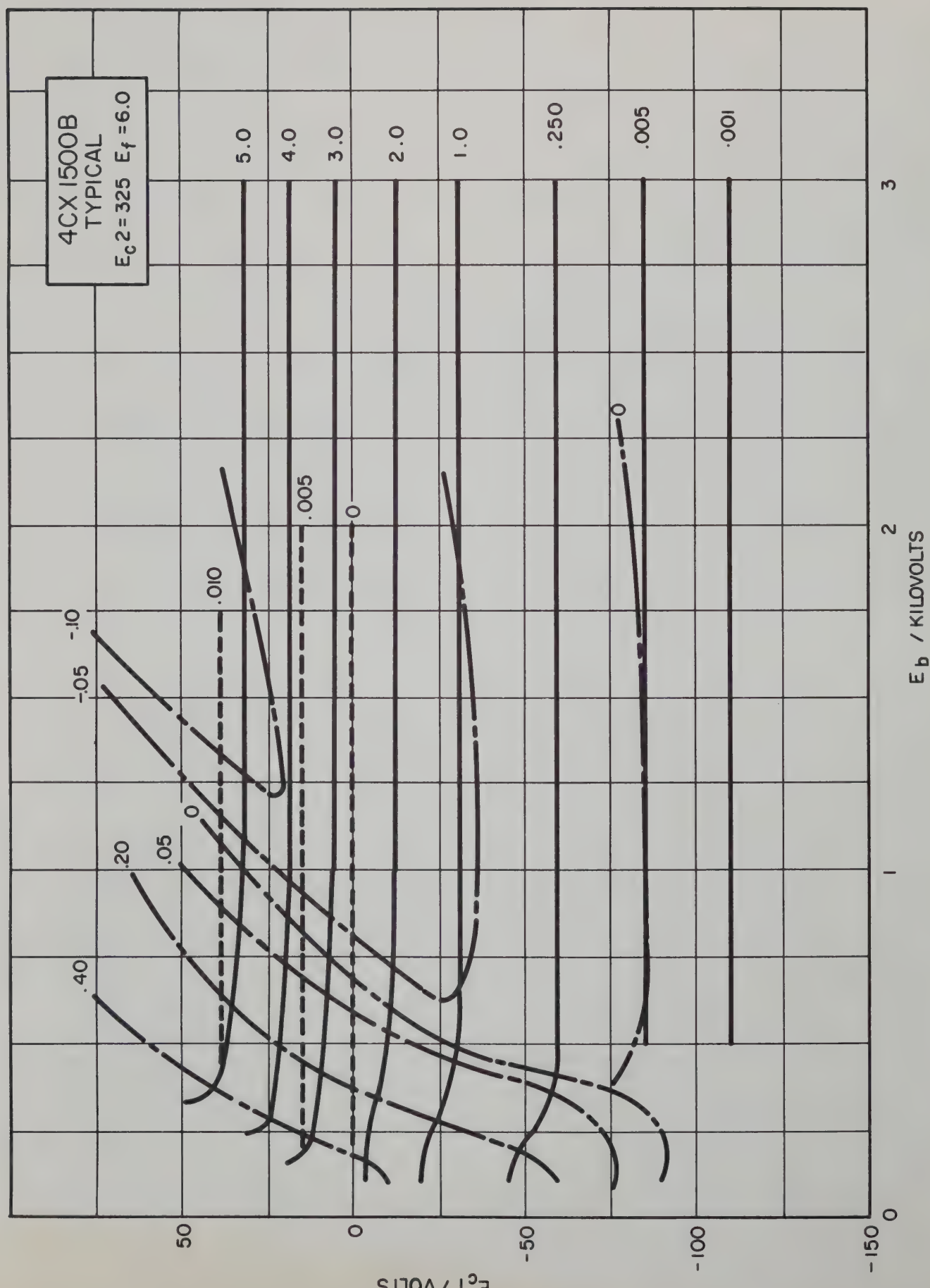

EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250 mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT — WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2900 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250 mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2500 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300 mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


4CX1500B
TYPICAL
Ec2 = 225 Ef = 6.0
4.0 A
3.0
2.0
1.0
.25
.005
.001
Ic1 = .01
-.10
-.05
.03 A
.005
.02
0
-.10
-.05
0
.05
.10
.20A
50
0
-50
-100
-150
Ec1 / VOLTS
0
1
2
3
Eb / KILOVOLTS


4CX 1500B
TYPICAL
Ec2 = 325 Ef = 6.0
5.0
4.0
3.0
2.0
1.0
.250
.005
.001
.010
.005
0
0
.005
.05
.20
.40
-.05
-.10
50
0
-50
-100
-150
Ec1 / VOLTS
0
1
2
3
Eb / KILOVOLTS

EIMAC

A Division of Varian Associates

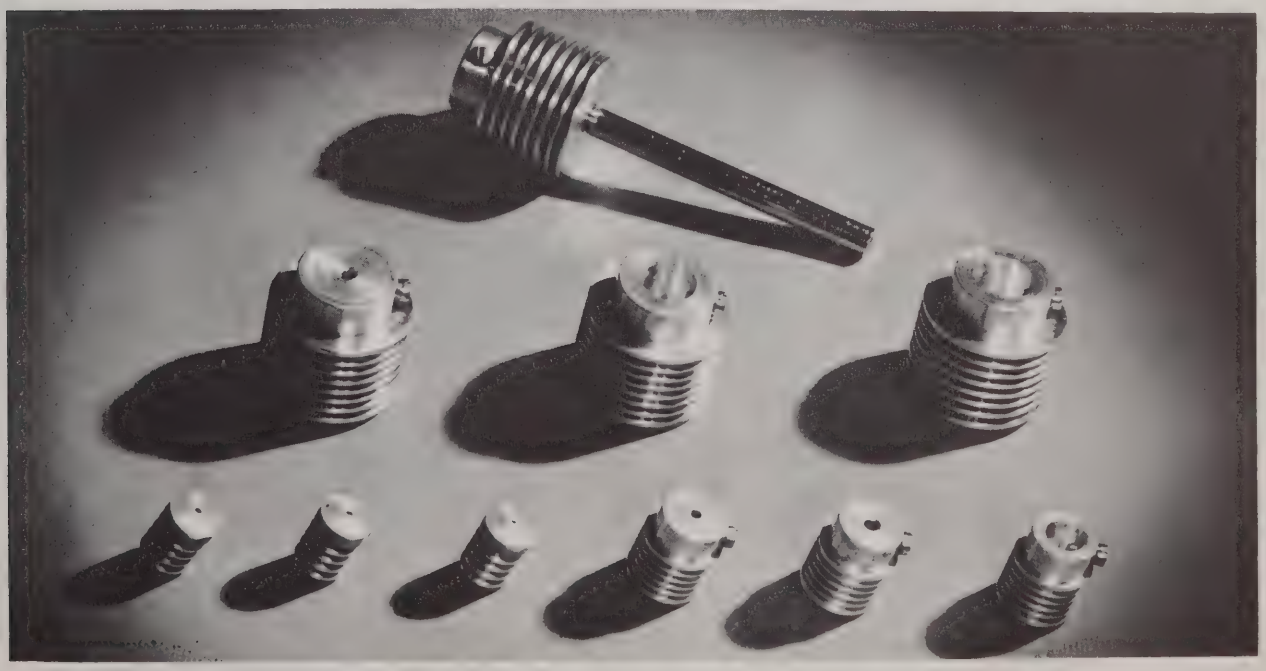
HR HEAT DISSIPATING CONNECTORS

Eimac HR Heat-Dissipating Connectors are used to make electrical connections to the plate and grid terminals of Eimac tubes, and, at the same time, provide efficient heat transfer from the tube element and glass seal to the air. The HR connectors aid materially in keeping seal temperatures at safe values. However, it is sometimes necessary to forced-air cool the connector by means of a small fan or blower. In such cases the air flow should be parallel with the fins of the connector. Designed for use on the larger tubes, the HR-9 Heat-Dissipating Connector is provided with an air duct to conduct the cooling air directly to the glass seal.

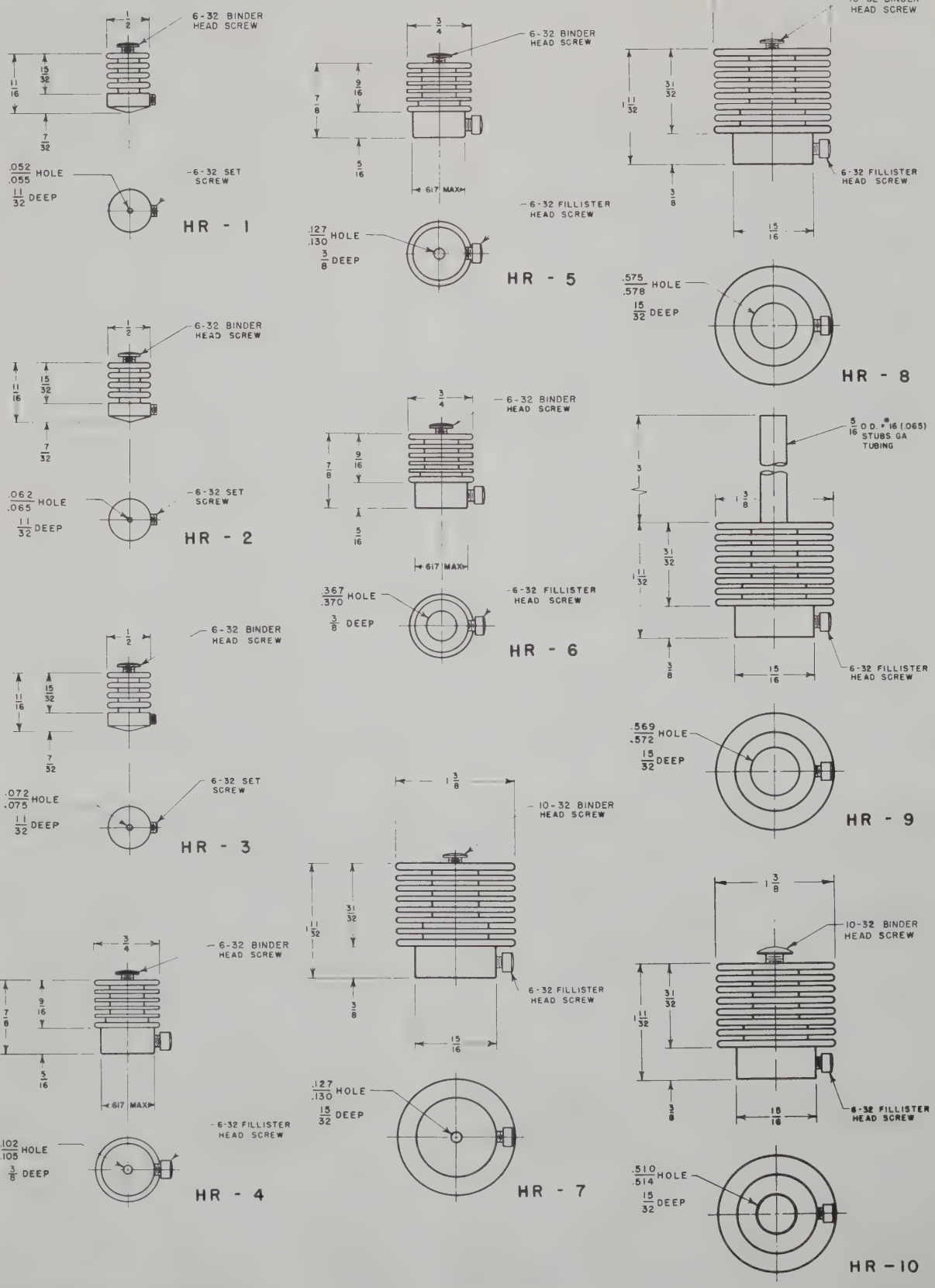
HR Heat-Dissipating Connectors are machined from solid dural rod, and are supplied with the necessary machine screws. The table below lists the proper connectors for use with each Eimac tube type.

TUBE	PLATE CONNECTOR	GRID CONNECTOR	TUBE	PLATE CONNECTOR	GRID CONNECTOR
2-25A	HR-1	.....	75TH-TL	HR-3	HR-2
2-50A	HR-3	.....	100R	HR-8	.....
2-150D	HR-6	.....	100TH-TL	HR-6	HR-2
2-240A	HR-6	.....	VT127A	HR-3	HR-3
2-2000A	HR-8	.....	152TH-TL	HR-5	HR-6
3C24	HR-1	HR-1	250TH-TL	HR-6	HR-3
4-65A	HR-6	.....	250R	HR-6	.....
4-125A	HR-6	.....	253	HR-8	.....
4-250A	HR-6	.....	304TH-TL	HR-7	HR-6
4-400A	HR-6	.....	327A	HR-4	HR-3
4-1000A	HR-8	.....	450TH-TL	HR-8	HR-8*
4E27A/5-125B	HR-5	.....	592/3-200A3	HR-10	HR-5
4PR60A	HR-8	.....			
6C21	HR-8	HR-8			
KY21A	HR-3	.....	750TL	HR-8	HR-8
RX21A	HR-3	.....	866A	HR-8	.....
25T	HR-1	.....	872A	HR-8	.....
35T	HR-3	.....	1000T	HR-9	HR-9
35TG	HR-3	HR-3	1500T	HR-8	HR-8
UH50	HR-2	HR-2	2000T	HR-8	HR-8

*The grid terminal of the 450TH-TL type tube is now .563" in diameter. To accommodate existing equipment designed for the older style 450TH-TL having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal requires an HR-4 connector.



(Effective 12-1-65) Copyright 1954, 1965 by Varian Associates


6-32 BINDER HEAD SCREW
1/2
11/16
15/32
7/32
.052/.055 HOLE
11/32 DEEP
6-32 SET SCREW
HR - 1
6-32 BINDER HEAD SCREW
1/2
11/16
15/32
7/32
.062/.065 HOLE
11/32 DEEP
6-32 SET SCREW
HR - 2
6-32 BINDER HEAD SCREW
1/2
11/16
15/32
7/32
.072/.075 HOLE
11/32 DEEP
6-32 SET SCREW
HR - 3
6-32 BINDER HEAD SCREW
3/4
7/8
9/16
5/16
.617 MAX
.102/.105 HOLE
3/8 DEEP
6-32 FILLISTER HEAD SCREW
HR - 4
6-32 BINDER HEAD SCREW
3/4
7/8
9/16
5/16
.617 MAX
.127/.130 HOLE
3/8 DEEP
6-32 FILLISTER HEAD SCREW
HR - 5
6-32 BINDER HEAD SCREW
3/4
7/8
9/16
5/16
.617 MAX
.367/.370 HOLE
3/8 DEEP
6-32 FILLISTER HEAD SCREW
HR - 6
1 3/8
10-32 BINDER HEAD SCREW
1 11/32
31/32
3/8
15/16
6-32 FILLISTER HEAD SCREW
.127/.130 HOLE
15/32 DEEP
HR - 7
1 3/8
10-32 BINDER HEAD SCREW
1 11/32
31/32
3/8
15/16
6-32 FILLISTER HEAD SCREW
.575/.578 HOLE
15/32 DEEP
HR - 8
5/16 O.D. * 16 (.065) STUBS GA TUBING
3
1 3/8
1 11/32
31/32
3/8
15/16
6-32 FILLISTER HEAD SCREW
.569/.572 HOLE
15/32 DEEP
HR - 9
1 3/8
10-32 BINDER HEAD SCREW
1 11/32
31/32
3/8
15/16
6-32 FILLISTER HEAD SCREW
.510/.514 HOLE
15/32 DEEP
HR - 10

EIMAC

A Division of Varian Associates

X6065

HIGH VACUUM HIGH CURRENT ELECTRICAL FEEDTHROUGH

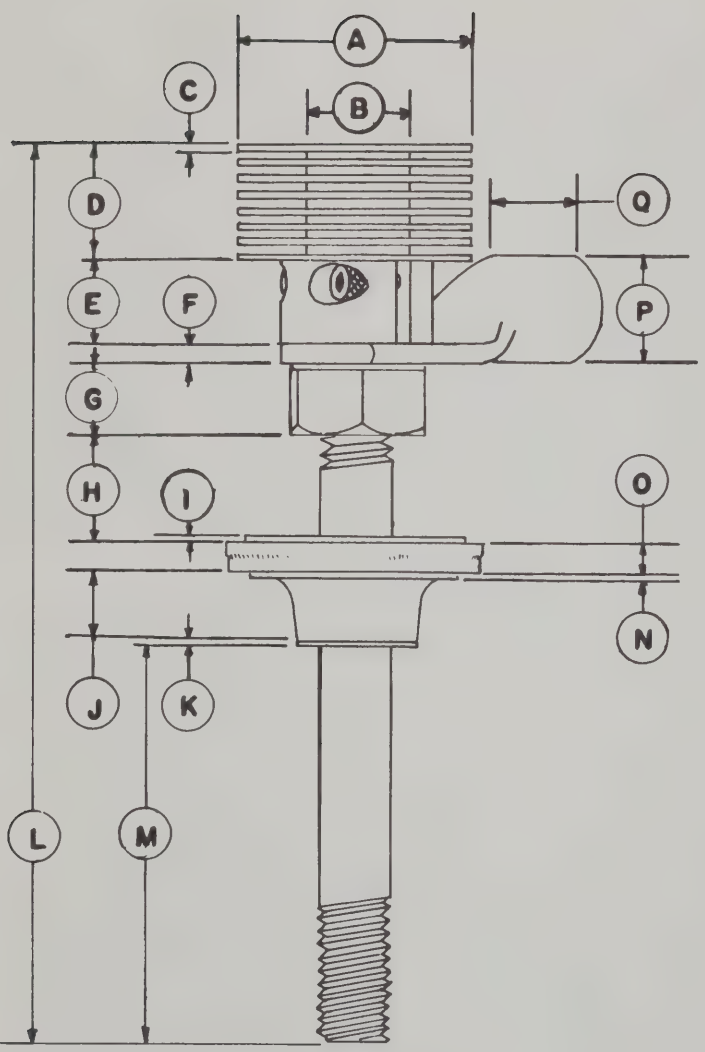


The EIMAC X6065 high vacuum, high current feedthrough is designed to provide reliable performance at low cost. The X6065 features an outer shell designed to be furnace brazed into the vacuum chamber and provides a thin lip which can be conveniently tungsten inert gas welded to the feedthrough. The feedthrough may also be directly tungsten inert gas welded to the vacuum system. A unique feature of the X6065 is the anodized aluminum radiator which provides increased current handling capability over non-cooled feedthroughs. The X6065 uses OFHC copper and nickel plated Kovar components. An alumina insulator and metal to ceramic seal insures an excellent vacuum seal without the use of organic material components.

SPECIFICATION

Voltage	600 V
Current	325 amperes (with radiator)
Temperature	400°C maximum
Thermal Shock	25°C/minute maximum rate of change
Feedthrough part size	1.430/1.433
Vacuum	1×10^{-10} Torr

(Effective March 15, 1966) © 1966 Varian Associates Printed in U.S.A.



REF. — NOM.
A — 39/32
B — 17/32
C — 5/64
D — 19/32
E — 7/16
F — 3/32
G — 3/8
H — 17/32
I — 1/32
J — 11/32
K — 1/32
L — 4 5/8
M — 2 5/64
N — 1/32
O — 5/32
P — 17/32
Q — 7/16

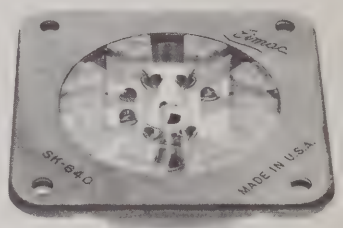
EIMAC

A Division of Varian Associates

SK-640

AIR-SYSTEM SOCKET

The Eimac SK-640 is one of the air system sockets recommended for use with those tubes listed at bottom of the page, or other tube types having the same special nine-pin base, when an integral screen by-pass capacitor is either not required or desired. When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-640 Air-System Socket is humidity and salt-spray resistant.



BASE CONNECTIONS

The SK-640 Air-System Socket consists of seven base pin contacting terminals (no contact is made to Pin #5) and a center control-grid terminal. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are insulated from the socket body. Connection to the screen-grid is made via Pin #1 while control-grid contact is accomplished by the use of a 6/32″ screw at the center terminal.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is nickel-plated brass and the base pin contact terminals are fabricated from beryllium-copper, heat treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water-vapors and is not affected by acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to + 199° C and it is resistant to embrittlement and thermal shock.

NET WEIGHT ..... 2.0 ounces

INSTALLATION

The SK-640 Air-System Socket can be mounted on a chassis decks or partitions by the four 0.150 inch diameter holes provided in the socket body. These holes are 90° apart and are drilled on a 2-9/16″ diameter pitch circle. A 2-1/4″ hole is required to accept the socket body.

TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-640 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

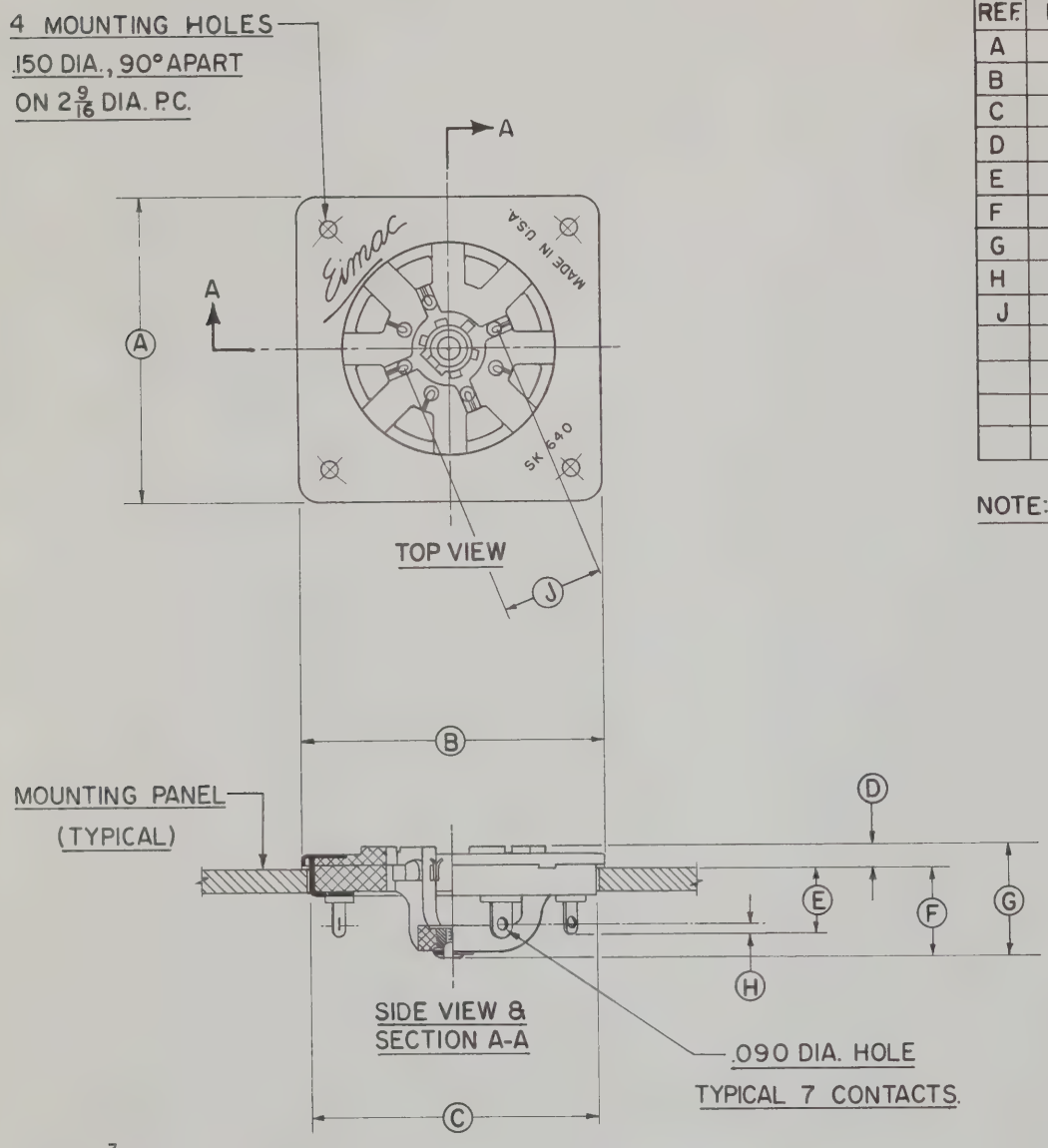
THE SK-640 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

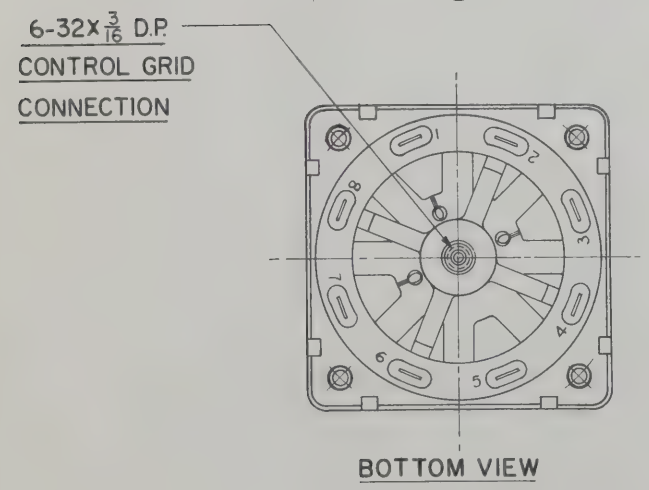
7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

(Revised 2-15-66) Copyright 1961, 1966 by Varian Associates

DIMENSIONS IN INCHES			
REF.	MIN.	MAX.	NOM.
A			2.314
B			2.314
C			2.194 D.
D			.167
E			.548
F			.712
G			.879
H			.089
J			.687 DIA.

NOTE: TOLERANCES ARE NOT CUMULATIVE





CONNECTIONS
1. SCREEN GRID
2. CATHODE
3. HEATER
4. CATHODE
5. NO CONNECTION
6. CATHODE
7. HEATER
8. CATHODE

Printed in U.S.A. 990

EIMAC

A Division of Varian Associates

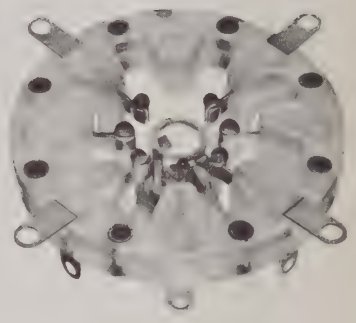
SK-650
SK-655

AIR-SYSTEM SOCKET

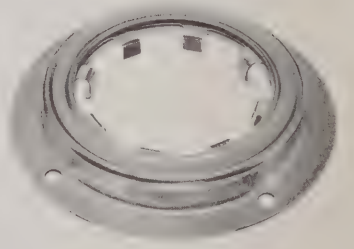
The Eimac SK-650 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of the page, or other tube types having the same special nine-pin base, when a compact, low-cost, special purpose socket is required. When this socket is used, connection is made to each of the tube electrodes except the anode.

The SK-655 Screen By-Pass Capacitor is a separate encapsulated capacitor designed for use with the SK-650 Air-System Socket. When this combination is used, the screen by-pass capacitor can be replaced without troublesome or costly repairs.

Both the SK-650 and the SK-655 are humidity and salt-spray resistant.



SK-650
Air-System Socket



SK-655 Screen
By-Pass Capacitor

BASE CONNECTIONS

The SK-650 Air-System Socket consists of seven base pin contacting terminals (no contact is made to Pin #5) and a center control-grid terminal. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which, in turn, are connected to the four socket mounting tabs. Connections are made in this manner to minimize the effects of lead inductance. When the SK-650 Air-System Socket is used alone, connection is made to the screen-grid via Pin #1. Control grid contact is accomplished by means of a 6/32″ screw at the center terminal.

THE SK-655 SCREEN-GRID BY-PASS CAPACITOR

The SK-655 Screen-Grid By-Pass Capacitor is an independent encapsulated capacitor which is mounted to the SK-650 Air-System Socket by the same four socket mounting screws. This is a low-inductance capacitor, 1100 uuf ± 20%, which provides a short radio-frequency path to ground. The capacitor is hi-voltage breakdown tested at 2000 volts d-c and rated at 1000 volts d-c. When the SK-655 is mounted on a grounded chassis, one side of the screen by-pass capacitor is automatically grounded.

MATERIALS AND FINISHES

In the SK-650 Air-System Socket, the base pin terminals and the four mounting lugs are fabricated of beryllium-copper, heat treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass.

The insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water-vapors and is not affected by acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

The SK-655 Screen By-Pass Capacitor has a body, or shell, constructed of silver-plated brass while the eight screen-grid contacting fingers are heat treated, silver-plated beryllium-copper. The capacitor dielectric is silvered-mica and is encapsulated in epoxy resin.

Net Weight of the SK-650 Air-System Socket ..... 1.2 ounces

Net Weight of the SK-655 Screen-Grid By-Pass Capacitor ..... 1.5 ounces

INSTALLATION

Both the SK-650 Air-System Socket and the SK-655 Screen-Grid By-Pass Capacitor can be mounted to a chassis deck or partition by the four 0.130″ diameter holes provided in each of the assemblies. Both units have holes which are 90° apart and are drilled on 2-17/32″ diameter pitch circle.

The SK-650 Air-System Socket requires a 2-1/8″ diameter hole to accept the socket body.

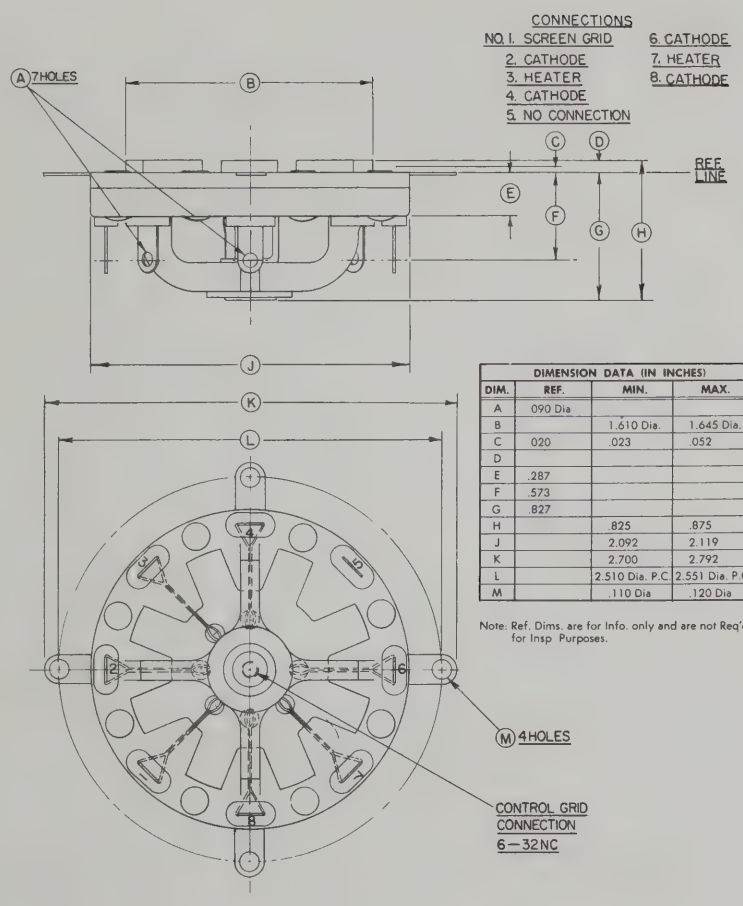
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-650 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-650 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

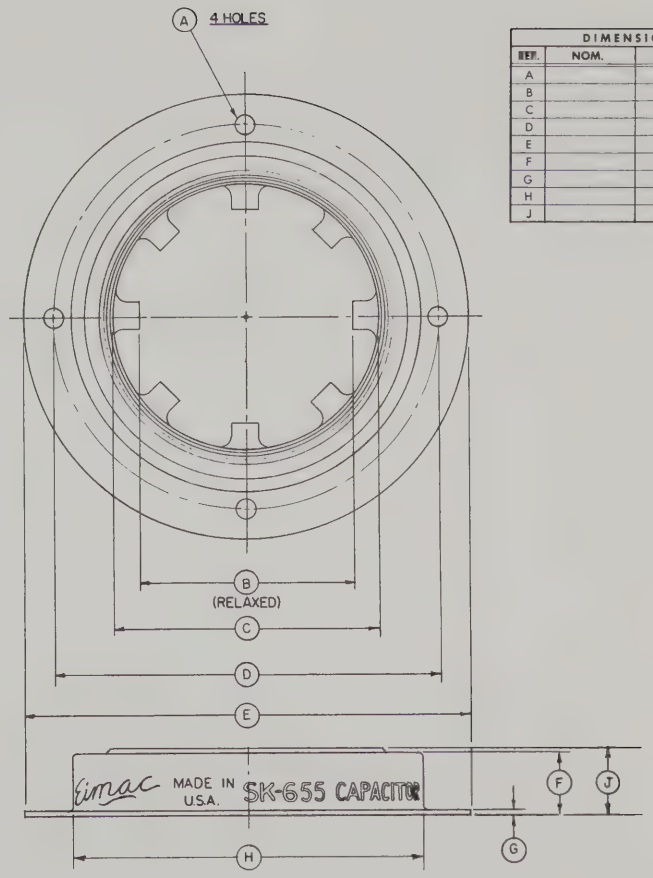
(Revised 1-15-66) Copyright 1961, 1966 by Varian Associates



DIMENSION DATA (IN INCHES)			
DIM.	REF.	MIN.	MAX.
A	090 Dia		
B		1.610 Dia.	1.645 Dia.
C	020	.023	.052
D			
E	.287		
F	.573		
G	.827		
H		.825	.875
J		2.092	2.119
K		2.700	2.792
L		2.510 Dia. P.C.	2.551 Dia. P.C.
M		.110 Dia	.120 Dia

Note: Ref. Dims. are for Info. only and are not Req'd for Insp. Purposes.

SK-650 OUTLINE DRAWING



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		.125	.135
B		1.330	1.390
C		1.680	1.725
D		2.520	2.560
E		2.858	2.891
F		.380	.410
G		.025	.037
H		2.280	2.310
J		.400	.430

SK-655 OUTLINE DRAWING

Printed in U.S.A. 991



EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

TABLE OF CONTENTS

VOLUME I

GENERAL	Effective Date
Tube Type Numbering System	4-3-58
Distributors	5-15-66
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet	1-1-67
Power Frequency Chart for Power Grid	

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	12-15-65
2-240A	10-21-59
2-450A	3-1-66
2-2000A	7-1-52
2X3000F	6-1-63
250R	12-15-65
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	11-1-66
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	6-1-66
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65
KY21A	7-1-66
RX21A	1-2-63

TRIODES

2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	3-15-67
3-1000Z/8164	11-16-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	3-1-67
3CW5000H3	4-1-66
3CW10,000H3	7-15-66
3CW20,000A1	1-1-63
3CW20,000A3	6-1-66
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	3-1-67
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-15-66
3CX2500A3/8161	12-15-64
3CX2500F3	3-1-67
3CX2500H3	3-15-66

*Not recommended for New Equipment Design.

TRIODES (Continued)	Effective Date
3CX5000H3	4-1-66
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	11-1-63
3CX10,000H3	3-15-66
3CX15,000A3	4-11-64
3CX15,000H3	4-1-66
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
25T	12-15-65
35T	12-30-57
*35TG	5-1-62
75TH	12-15-65
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	6-15-66
250TL	1-1-61
304TH	4-10-53
304TL	12-15-65
450TH	12-15-65
450TL	12-15-65
592/3-200A3	6-15-66
750TL	12-15-65
1000T	12-15-65
1500T	3-18-59
2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES

4-65A/8165	5-1-62
4-125A	12-15-65
4-250A/5D22	5-1-62
4-400A	8-30-66
4-1000A/8166	10-30-66
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	5-15-66
4CV100,000C/8351	3-15-65
4CW2000A	6-15-66
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61

TETRODES–PENTODES (Continued)	Effective Date
4CX300A/8167	8-30-66
4CX300Y	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX600A	5-7-63
4CX1000A/8168	6-15-66
4CX1000K/8352	8-20-66
4CX1500B	4-1-67
4CX3000A/8169	9-16-65
4CX5000A/8170	10-1-64
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	8-15-66
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	8-30-66
4X150G/8172	6-15-66
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5-500A	11-15-65
5CX1500A	2-15-65

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
Preformed Contact Finger Stock	8-15-66
HR Heat Dissipating Connectors	12-1-65
SK-300A	11-1-64
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	11-1-65
SK-410	11-15-62
SK-500	3-15-67
SK-506, SK-516	8-15-64
SK-510	8-15-66
SK-600A, SK-610A	11-1-65
SK-606, SK-626, SK-636B	8-15-66
SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A	5-9-63
SK-740	8-15-66
SK-760, SK-770	8-15-66
SK-800B, SK-806	4-9-64
SK-810B, SK-806	4-9-64
SK-860, SK-870	3-15-67
SK-890B, SK-806	4-9-64
SK-900, SK-906	8-15-66
SK-1300	8-15-66
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66

Effective Date 5-1-67



EIMAC
Division of Varian
SAN CARLOS, CALIFORNIA

EIMAC and EIA

POWER GRID TUBE NUMBER CROSS-REFERENCE LIST

JANUARY 1, 1967

(Effective 11-15-65) Copyright 1965 by Varian Associates

Printed in U.S.A.

EIMAC to EIA

Eimac No.	*EIA No.*
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
322	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV30, 000A1	----
3CV30, 000A3	----
3CV30, 000H3	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10, 000A3	----
3CW10, 000H3	----
3CW20, 000A1	----
3CW20, 000A3	----
3CW20, 000A7	----
3CW20, 000H3	----
3CW25, 000A3	----
3CW30, 000H3	----
3CW40, 000H3	----
3CW100, 000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10, 000A1	8158
3CX10, 000A3	8159
3CX10, 000A7	8160
3CX10, 000H3	----

Eimac No.	*EIA No.*
3CX15, 000A3	----
3CX15, 000H3	----
3CX20, 000A3	----
3CX20, 000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CV1500B	----
4CV8000A	----
4CV20, 000A	----
4CV35, 000A	----
4CV100, 000C	8351
4CV250, 000A	----
4CV250, 000V	----
4CW800A	----
4CW2000A	8244
4CW10, 000A	----
4CW25, 000A	----
4CW50, 000C	8350
4CW100, 000D	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX600A	----
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000R	8170W
4CX10, 000D	8171
4CX15, 000A	8281
4CX35, 000C	8349
4PR60B	8252
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188

Eimac No.	*EIA No.*
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20, 000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X150R	8296
4X150S	8297
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250R	----
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
673	673
750TL	750TL
826	826
869B	869B
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6696A	6696A
6697A	6697A
6884	6884
6894	6896
6895	6895
7211	7211
7527	7527
7843	7843

NUMBER CROSS-REFERENCE LIST

EIA to EIMAC

EIA No.	Eimac No.
2C39A	2C39A
2C39WA	2C39WA
4D21	4-125A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156

EIA No.	Eimac No.
6696A	6696A
6697A	6697A
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7480	7480
7527	7527
7580W	4CX250R
7698	7698
7815	3CPN10A5
7815R	3CPX100A5
7843	7843
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G

EIA No.	Eimac No.
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8281	4CX15,000A
8283	3CX1000A7
8296	4X150R
8297	4X150S
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8350	4CW50,000C
8351	4CV100,000C
8352	4CX1000K
8438	4-400A
8561	4CX300Y
8590	4CPX250K
8660	4CX1500B


Eimac

EIMAC
Division of Varian

8252
4PR60B

RADIAL-BEAM PULSE TETRODE
●
MODULATOR AMPLIFIER

The EIMAC 8252/4PR60B is a high-vacuum tetrode intended for pulse-modulator service in circuits employing inductive or resistive loads. This tube unilaterally replaces the 715C and the 5D21 and supersedes the 4PR60A.

The 8252/4PR60B has a maximum plate dissipation rating of 60 watts, is cooled by radiation and convection, and delivers pulse output power in the region of 300 kilowatts with less than one kilowatt of pulse driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-coated, Unipotential				
Heater Voltage		26.0		volts
Heater Current		2.1		amperes
Cathode Heating Time	3	5		minutes
Direct Interelectrode Capacitances				
Grid-Plate			2.0	pF
Input	35		50	pF
Output	6.0		11	pF

MECHANICAL

Minimum Shock Test	190 g, 0.5 ms half sine
Base	Fits E. F. Johnson Co. Socket Number 122-234 or equivalent
Mounting Position	Any
Cooling	Radiation and Convection
Recommended Heat Dissipating Plate Connector	EIMAC HR-8
Maximum Seal and Envelope Temperatures	200°C
Maximum Over-All Dimensions	
Length	6.000 inches
Diameter	3.063 inches
Net Weight	12 ounces
Shipping Weight	2.5 pounds

RATINGS

MAXIMUM RATINGS—Pulse Modulator Service (Per Tube)

DC PLATE VOLTAGE	20 KILOVOLTS
DC SCREEN VOLTAGE	1.5 KILOVOLTS
DC GRID VOLTAGE†	—1.0 KILOVOLT
PEAK POSITIVE GRID VOLTAGE	300 VOLTS
PEAK PLATE CURRENT	18 AMPERES
PEAK POSITIVE PLATE VOLTAGE	25 KILOVOLTS
PLATE DISSIPATION (AVERAGE)	60 WATTS
SCREEN DISSIPATION (AVERAGE)	8 WATTS
GRID DISSIPATION (AVERAGE)	1 WATT
DUTY	See chart page 4

†Effective grid-circuit resistance must not exceed 100,000 ohms.

TYPICAL OPERATION

Pulse Modulator (Per Tube)			
DC Plate Voltage	16.0	20.0	kilovolts
Pulse Plate Current	10.0	18.0	amperes
DC Screen Voltage	1.25	1.25	kilovolts
Pulse Screen Current*	1.8	2.7	amperes
DC Grid Voltage	—550	—600	volts
Pulse Grid Current*	0.20	0.75	ampere
Pulse Positive Grid Voltage	30	150	volts
Duty	0.0025	.001	
Pulse Duration	5	2	μsec
Peak Positive Plate Voltage	25	25	kilovolts
Pulse Input Power	160	360	kilowatts
Pulse Output Power	150	337	kilowatts
Pulse Output Voltage	15.0	18.75	kilovolts

*Approximate value.

(Revised 11-1-66) © 1962, 1966 Varian

Printed in U.S.A.

APPLICATION

MECHANICAL

Mounting—The 4PR60B may be mounted and operated in any position. A flexible connecting strap must be provided between the plate terminal and the external plate circuit.

The 4PR60B is designed to withstand 200g shocks of 0.5 millisecond duration transferred to the tube through clamps on the metal skirt. Such clamps must be shaped to fit the contour of the skirt and must be fastened to the tube before being tightened to the chassis in order that no distorting force will be applied. No lateral pressure or clamping action should be applied to the base pins or to any part of the tube other than the skirt. The skirt is internally connected to the cathode. The 4PR60B must be protected from severe vibration.

Cooling — Adequate ventilation must be provided so that seal and/or envelope temperatures do not exceed 200°C under any operating or standby condition. When the 4PR60B is operated where air circulation is restricted, these temperatures can easily reach 225°C or more which will accelerate seal deterioration and cause early tube failure.

Adequate control of the base temperature, in particular, is necessary. Envelope and plate-seal temperatures do not ordinarily require special attention provided that an HR-8 heat-dissipating plate connector is used. However, each individual application of the 4PR60B should be carefully evaluated to assure safe operating temperatures. A blower is usually required only when normal air circulation is restricted, when the ambient temperature exceeds 25°C, when the altitude is other than sea level, or when a combination of these factors exists.

ELECTRICAL

Heater Operation — The heater voltage, as measured directly at the heater pins, should be maintained at the rated value of 26.0 volts. Maximum variations in heater voltage must be kept within the range of 23.4 to 28.6 volts. Where consistent performance and long tube life are factors, the heater voltage must be kept within range of 24.7 to 27.3 volts. The peak pulse-emission capability of the cathode may be impaired at low heater voltages, and high heater voltages contribute to short tube life.

A heater noise test is conducted periodically on 4PR60B samples. This test insures that the heater/cathode assembly will not generate excessive rf noise during vibration over the frequency range of 10 to 50 cps.

A 500-hour heater cycling test is also conducted periodically on 4PR60B samples. This test consists of at least 1000 complete on-off cycles and insures that grid-to-cathode shorts will not occur as a result of cumulative hysteresis effects upon mechanical joints in the cathode assembly.

Cathode Operation — It is essential that the minimum cathode heating time of three minutes be observed prior to the flow of cathode current. Conservative design for reliable tube operation in pulse circuits dictates the use of five minutes minimum heating time.

The "Cathode Current Derating Chart" on page 4 depicts the current capabilities of the 4PR60B cathode at various pulse durations and duty factors. To use this chart, enter with pulse duration and note the intersection with desired pulse *cathode* current (the total of plate, screen, and grid currents during particular pulse condition). At this intersection read off values of maximum duty and/or pulse repetition rate.

Under a given set of operating conditions, element dissipations may limit the maximum permissible duty to a value less than that which cathode considerations would dictate. When this occurs, it will usually be found that screen dissipation is the limiting factor under low tube-voltage-drop conditions and that plate dissipation limits the maximum duty under high tube-voltage-drop conditions.

Control-Grid Operation — The average power dissipated by the control grid of the 4PR60B must not exceed one watt. Control-grid dissipation is not usually a limiting factor with this tube, but can be computed as the product of pulse grid current, pulse positive grid voltage, and duty factor. Similarly, pulse driving power is pulse grid current times pulse grid voltage swing (bias voltage plus positive grid voltage).

Screen-Grid Operation — The average power dissipated by the screen of the 4PR60B must not exceed eight watts. Screen dissipation is the product of dc screen voltage, pulse screen current, and duty factor. Excessive screen dissipation is likely to occur under conditions of low tube-voltage drop during conduction. This condition can be relieved by using a lower plate load resistance which will cause higher tube-voltage drop during conduction.

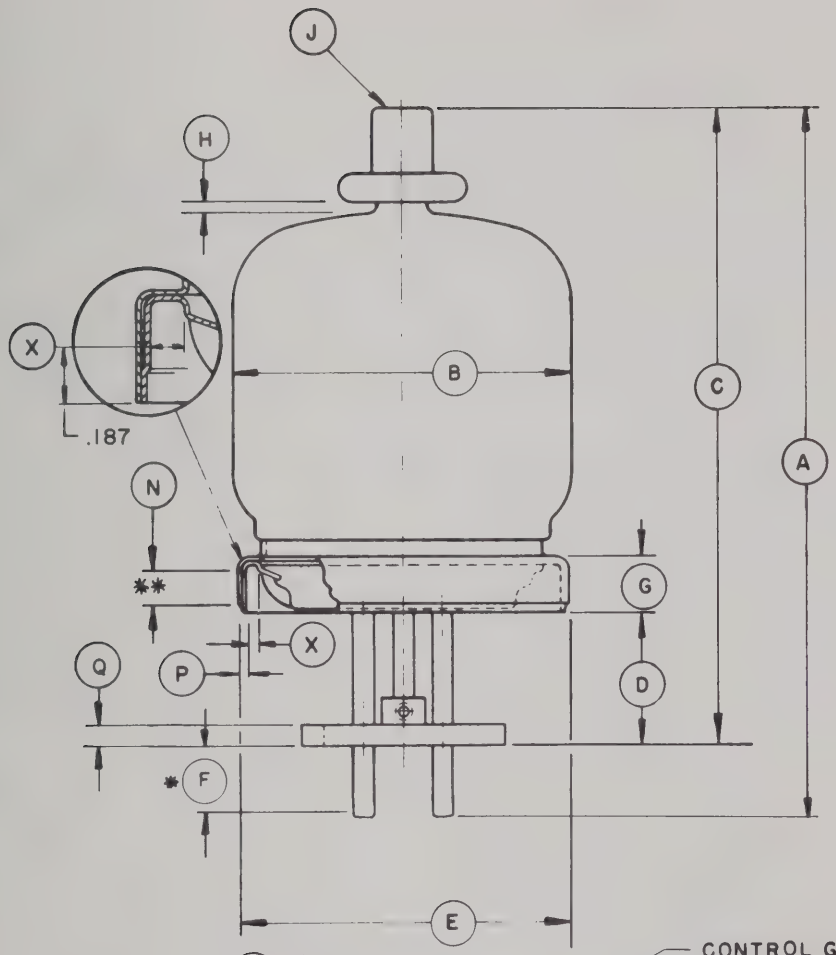
A bleeder resistance designed to draw at least 10 milliamperes of current should be connected directly from screen to cathode of the 4PR60B. This bleeder resistance will insure that only a positive current load is presented to the screen supply.

Plate Operation—The plate of the 4PR60B is radiation cooled and is rated at 60 watts maximum dissipation. Average plate dissipation must not exceed 60 watts. The 4PR60B should not be operated without a heat-dissipating plate connector such as the recommended EIMAC HR-8.

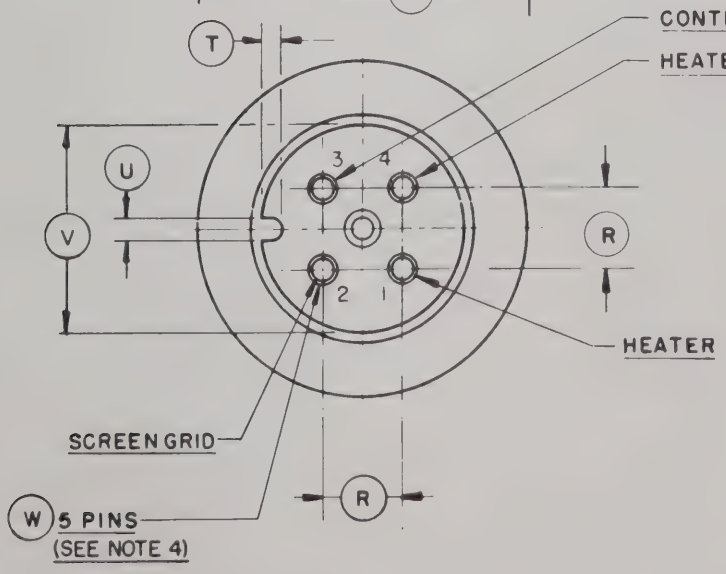
Average plate dissipation may be calculated as the product of pulse plate current, pulse tube-voltage drop, and duty factor. Excessive average plate dissipation is likely to occur at high values of pulse tube-voltage drop. The calculated value of plate dissipation may be well below 60 watts in a given case, but excessive dissipation may result if pulse rise and fall times are appreciable compared to pulse duration. This excessive plate dissipation occurs because long rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high voltage-drop region.

The plate-supply voltage for the 4PR60B should not exceed 20 kilovolts. In circuits employing inductive loading, the peak instantaneous plate voltage should not exceed 25 kilovolts.

4PR60B OUTLINE DRAWING AND DIMENSIONS

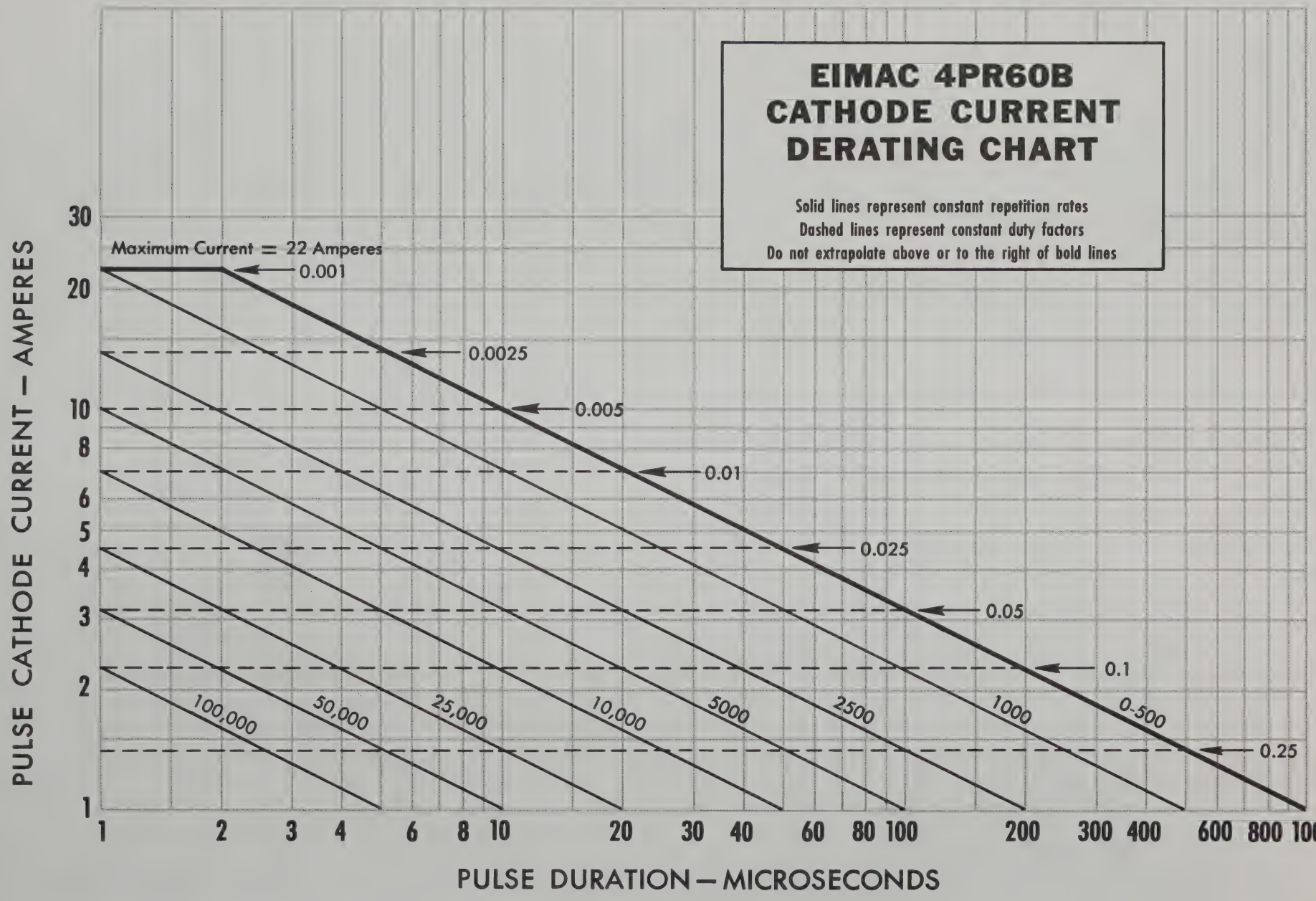


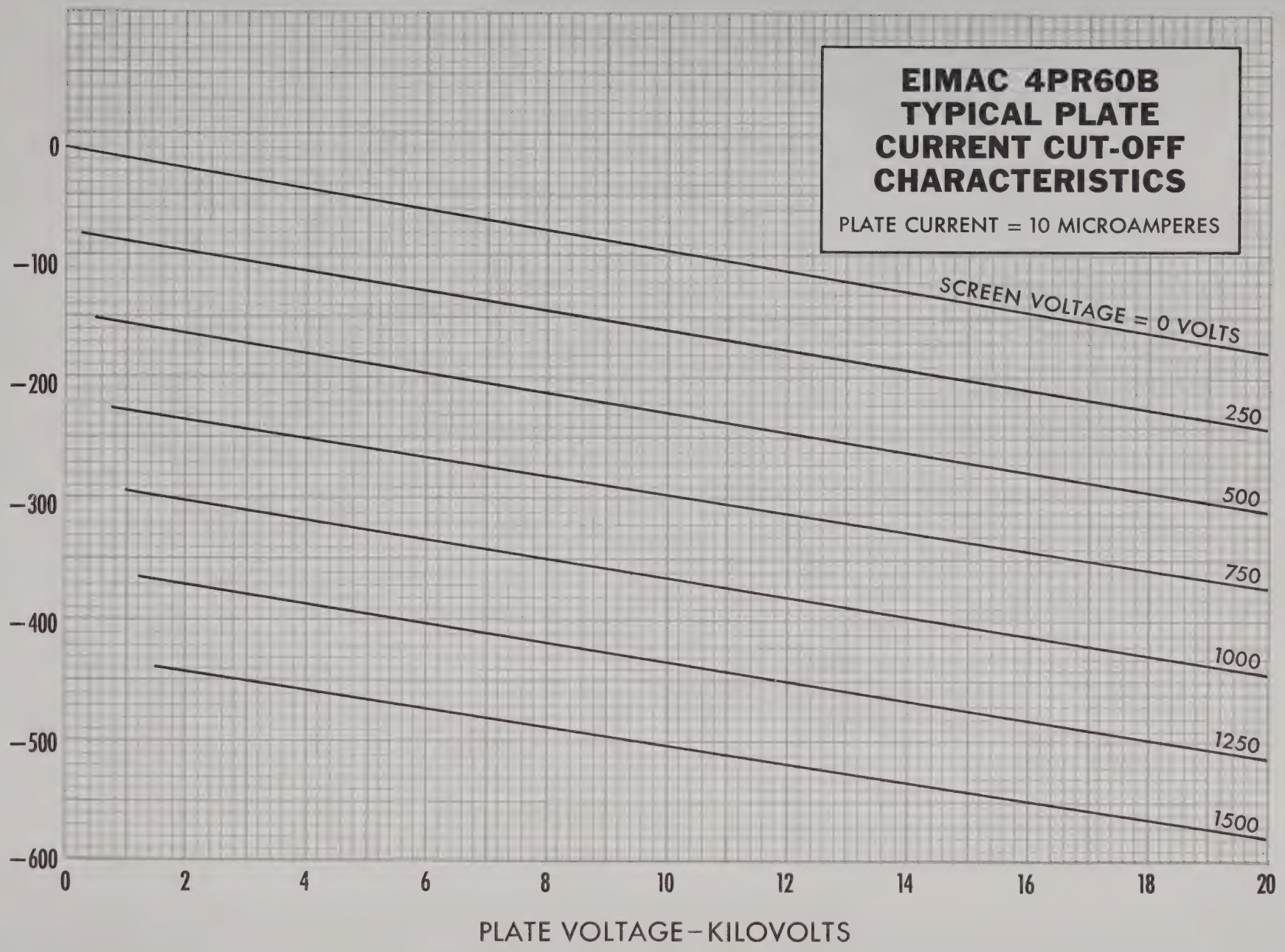
DIMENSION DATA		
REF.	MIN.	MAX.
A	5.750	6.000
B		3.063 DIA.
C	5.344	5.594
D	1.125	1.250
E	2.885 DIA.	2.905 DIA.
F	.328	
G	.438	.500
H	.016	
J	CAP: C1-41 (JEDEC DESIGNATION)	
N	.250	
P	.043	.057
Q	.188	
R	.687	
T	.171	.203
U	.171	.203
V	1.788 DIA.	1.813 DIA.
W	.183 DIA.	.191 DIA.
X	.157	

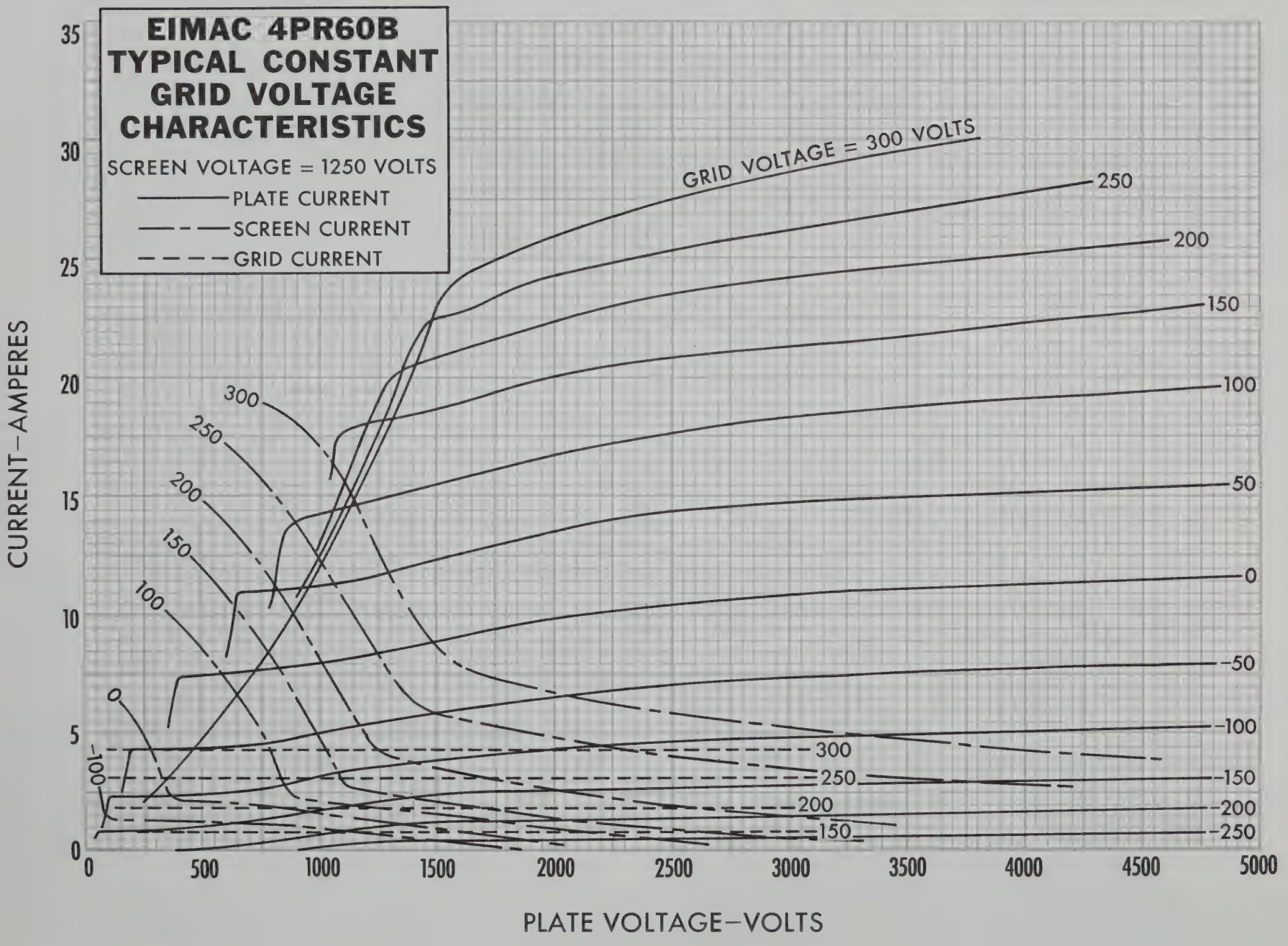


NOTES:

1. DIMENSIONS IN INCHES.
2. (*) CONTACT AREA.
3. (**) DEFINES CYLINDRICAL AREA AVAILABLE FOR CLAMPING WHICH MUST NOT BE DISTORTED BY CLAMPING ACTION.
4. THE BASE PINS SHALL BE CAPABLE OF ENTERING A GAUGE 1/4 INCH THICK HAVING FOUR .214" DIA. HOLES LOCATED ON 11/16 CENTERS AND A CENTER HOLE .250 DIA


EIMAC 4PR60B
CATHODE CURRENT
DERATING CHART
Solid lines represent constant repetition rates
Dashed lines represent constant duty factors
Do not extrapolate above or to the right of bold lines
Maximum Current = 22 Amperes
0.001
0.0025
0.005
0.01
0.025
0.05
0.1
0.25
0-500
1000
2500
5000
10,000
25,000
50,000
100,000
PULSE CATHODE CURRENT — AMPERES
30
20
10
8
6
5
4
3
2
1
1
2
3
4
6
8
10
20
30
40
60
80
100
200
300
400
600
800
1000
PULSE DURATION — MICROSECONDS


EIMAC 4PR60B
TYPICAL PLATE
CURRENT CUT-OFF
CHARACTERISTICS
PLATE CURRENT = 10 MICROAMPERES
SCREEN VOLTAGE = 0 VOLTS
250
500
750
1000
1250
1500
0
−100
−200
−300
−400
−500
−600
GRID VOLTAGE−VOLTS
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE−KILOVOLTS


EIMAC 4PR60B
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 1250 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
GRID VOLTAGE = 300 VOLTS
250
200
150
100
50
0
-50
-100
-150
-200
-250
300
250
200
150
100
0
-100
CURRENT–AMPERES
PLATE VOLTAGE–VOLTS
0
5
10
15
20
25
30
35
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

EIMAC
Division of Varian

8163
3-400Z

HIGH-MU POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	14.5	amperes
Amplification Factor (Average)	200	
Interelectrode Capacitances (Average):*		
Grid-Filament	7.4	pF
Grid-Plate	4.1	pF
Plate-Filament	0.07	pF
Frequency for Maximum Ratings	110	MHz

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-all Dimensions:	
Height	5.25 inches
Diameter	3.57 inches
Net Weight	7 ounces

*In Shielded Fixture

(Revised 3-15-67) © 1961, 1967 by Varian

Printed in U.S.A.

R-F LINEAR AMPLIFIER GROUNDED-GRID, CLASS-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Single-Tone Conditions)

DC Plate Voltage	3000 volts
Zero-Sig DC Plate Current*	100 ma
Max-Sig DC Plate Current	333 ma
Max-Sig DC Grid Current	120 ma
Driving Impedance	122 ohms
Resonant Load Impedance	4750 ohms
Max-Sig Driving Power	32 watts
Peak Envelope Plate Output Power	655 watts

TYPICAL OPERATION (Minimum Distortion Products)

DC Plate Voltage	2000 volts
Zero-Sig DC Plate Current*	62 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	148 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	87 ma
Peak Envelope Useful Output Power	445 watts
Resonant Load Impedance	2750 ohms
Intermodulation Distortion Products	—40 db

TYPICAL OPERATION (Minimum Distortion Products at 1 KW PEP Input)

DC Plate Voltage	2500 volts
Zero-Sig DC Plate Current*	73 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	142 ma
Two-Tone DC Plate Current	274 ma
Two-Tone DC Grid Current	82 ma
Peak Envelope Useful Output Power	560 watts
Resonant Load Impedance	3450 ohms
Intermodulation Distortion Products	—35 db

TYPICAL OPERATION (Minimum Distortion Products at 1500 Volts Plate Voltage)

DC Plate Voltage	1500 volts
Zero-Sig DC Plate Current*	46 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	163 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	92 ma
Peak Envelope Useful Output Power	300 watts
Resonant Load Impedance	1620 ohms
Intermodulation Distortion Products	—37 db

A-F AMPLIFIER OR MODULATOR, CLASS-B

MAXIMUM RATINGS (PER TUBE)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

DC Plate Voltage	3000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	200 ma
Max-Sig DC Plate Current	666 ma
Max-Sig DC Grid Current	240 ma
Driving Power	26 watts
Peak A-F Driving Voltage (per tube)	88 volts
Load Resistance, Plate-to-Plate	9500 ohms
Max-Sig Plate Output Power	1310 watts

R-F POWER AMPLIFIER OR OSCILLATOR, CLASS-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	0.350 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	333 ma
DC Grid Voltage	—75 volts
DC Grid Current	130 ma
Peak R-F Grid Voltage	187 volts
Grid Driving Power	25 watts
Plate Output Power	730 watts

R-F POWER AMPLIFIER PLATE-MODULATED

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.275 AMP
PLATE DISSIPATION	270 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	245 ma
DC Grid Voltage	—90 volts
DC Grid Current	100 ma
Peak R-F Grid Voltage	185 volts
Grid Driving Power	18 watts
Plate Output Power	550 watts

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

*Approximate Value

APPLICATION

Mounting — The 3-400Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling — Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an inlet air temperature of 55°C. At higher inlet air temperatures, higher altitudes, or at frequencies above 30 MHz, the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead. In all cases, air flow rates in excess of the minimum requirements will prolong tube life.

Class-C Operation — Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

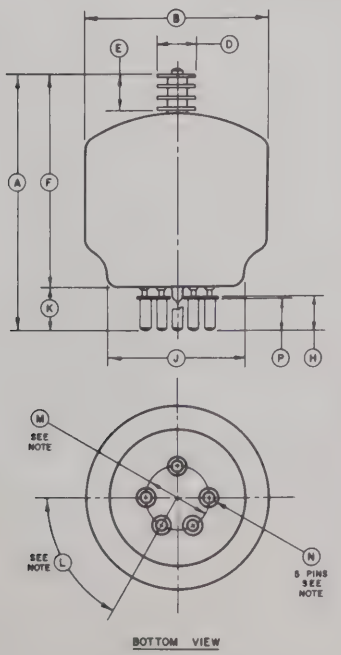
Filament Operation—The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

Intermodulation Distortion — Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

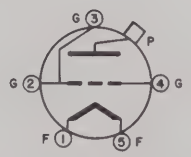
Input Circuit — When the 3-400Z is operated as a grounded-grid r-f amlpifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

3-400Z OUTLINE DRAWING AND PIN CONNECTIONS



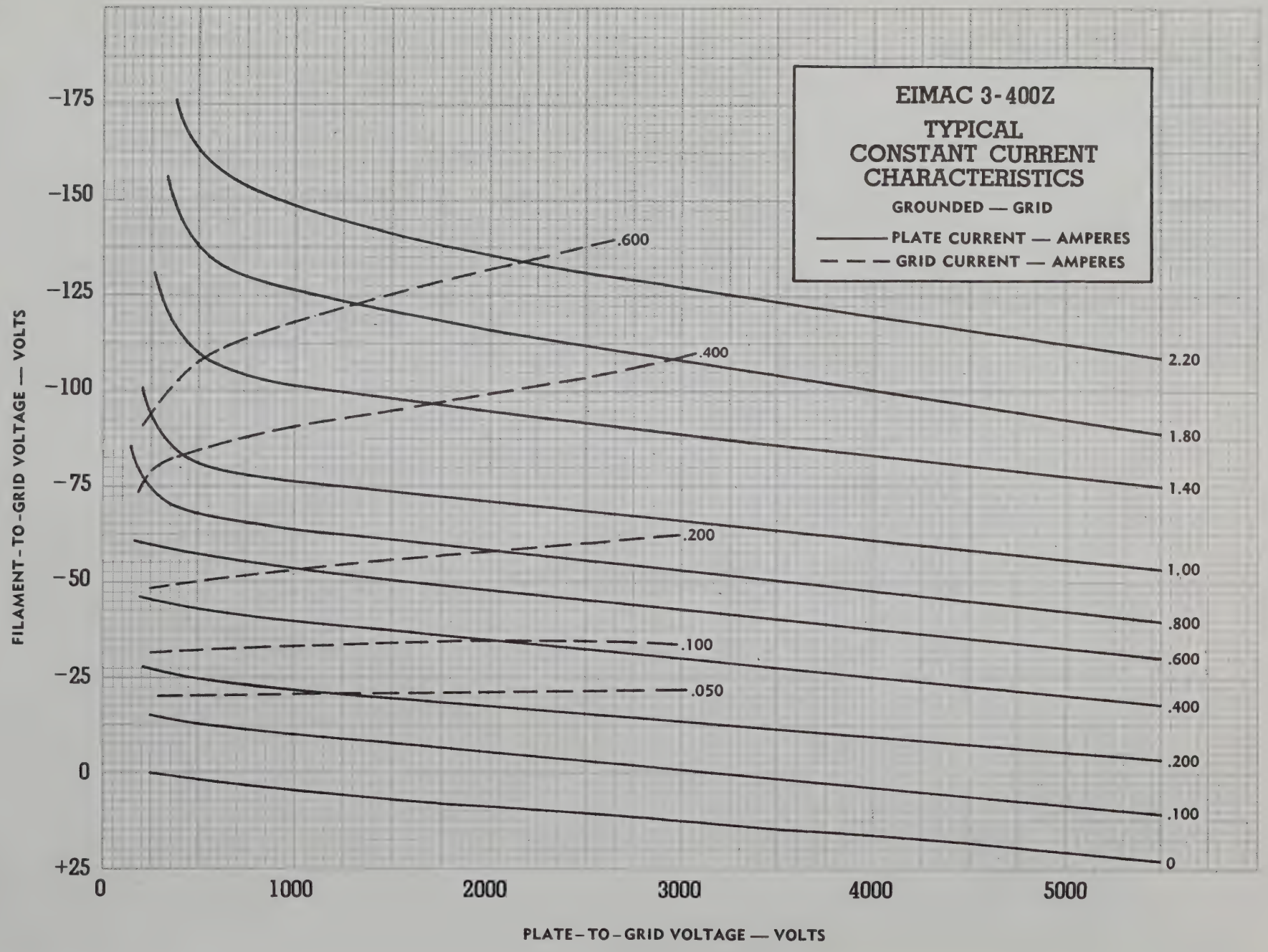
BOTTOM VIEW

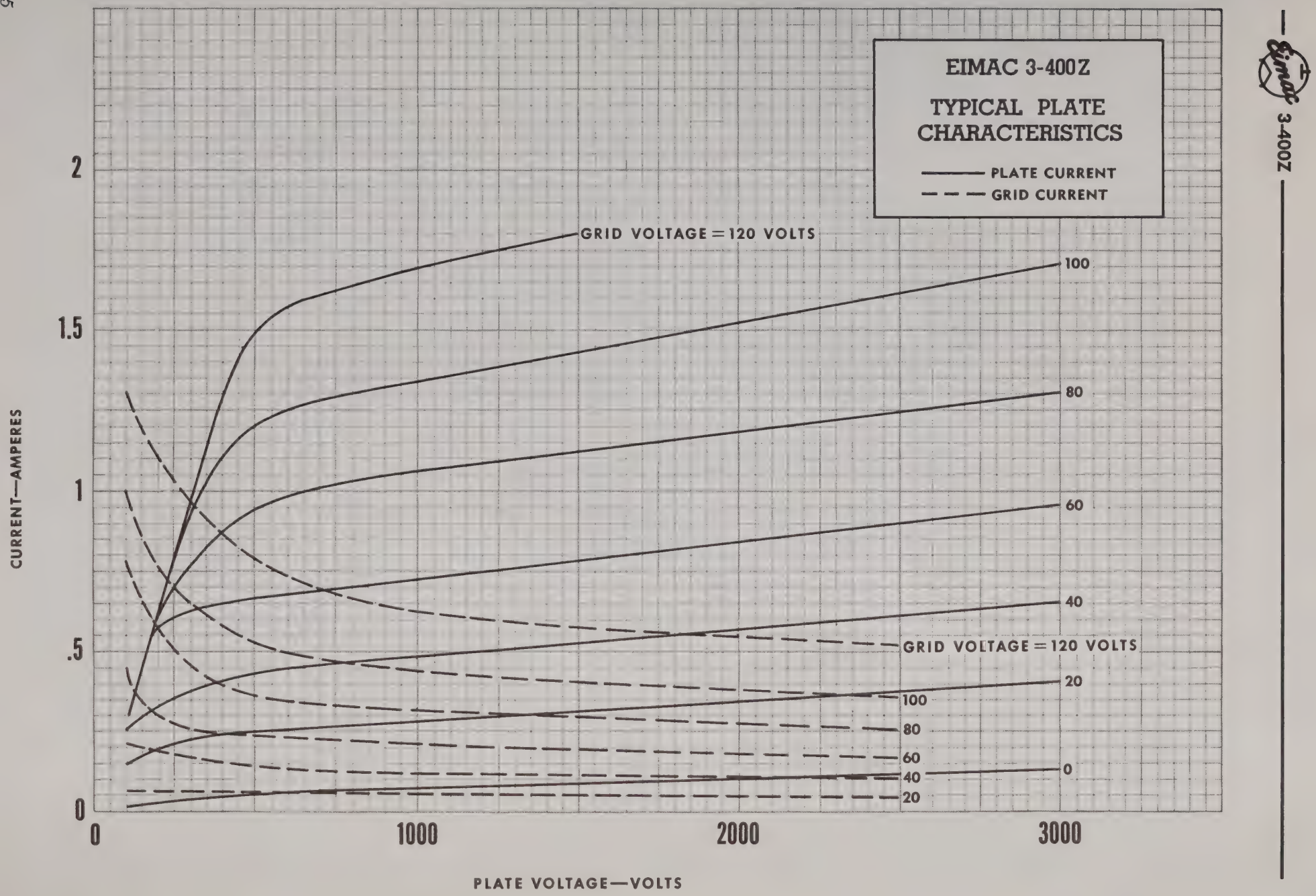


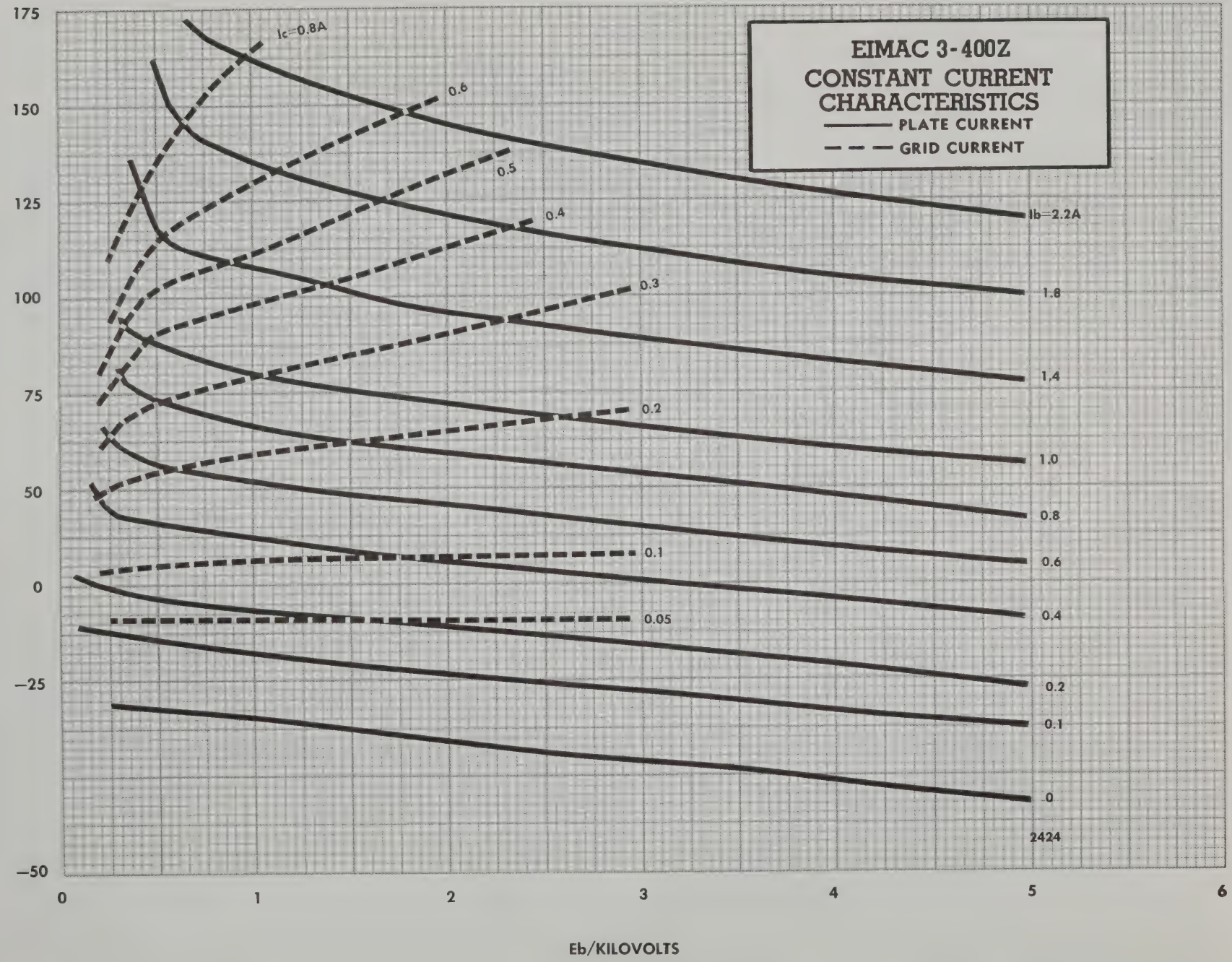
NOTE:
BASE PINS (N) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIAS. OF .204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMS. (L) & (M).

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4-3/4	5-1/4	
B		3-9/16 D.	
D	.745 D.	.755 D.	
E	.640	.660	
F	3-15/16	4-7/16	
H	9/16	11/16	
J		2-1/2 D.	
K			13/16
L			60° TYP.
M			1-1/4 D. P.C.
N	.185 D.	.191 D.	
P	1/2	5/8	


EIMAC 3-400Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED — GRID
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
FILAMENT-TO-GRID VOLTAGE — VOLTS
−175
−150
−125
−100
−75
−50
−25
0
+25
0
1000
2000
3000
4000
5000
PLATE-TO-GRID VOLTAGE — VOLTS
.600
.400
.200
.100
.050
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0


EIMAC 3-400Z
TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
0
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
CURRENT—AMPERES
PLATE VOLTAGE—VOLTS
0
.5
1
1.5
2
0
1000
2000
3000


EIMAC 3-400Z
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
Ic=0.8A
0.6
0.5
0.4
0.3
0.2
0.1
0.05
Ib=2.2A
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0
2424
175
150
125
100
75
50
0
−25
−50
0
1
2
3
4
5
6
Ec/VOLTS
Eb/KILOVOLTS

EIMAC
Division of Varian
CALIFORNIA

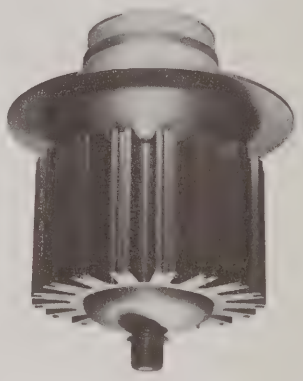
3CV30,000A3

MEDIUM-MU VAPOR-COOLED POWER TRIODE

The EIMAC 3CV30,000A3 is a vapor-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating service. Its vapor-cooled anode is conservatively rated at 30 kilowatts of plate dissipation when mounted in an EIMAC BR-200 boiler.

Full input of 60 kilowatts is permissible up to 100 megahertz. Large reserve emission is available from its one kilowatt filament and the grid structure is rated at one ampere making this tube an excellent choice for severe applications.

It is also recommended as a grounded grid FM amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		volts
Current	152		172	amperes
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF
Frequency for Maximum Ratings				100 MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1310
Recommended Boiler	EIMAC BR-200
Operating Position	Vertical, base up
Cooling	Vapor and Forced air
Maximum Operating Temperatures:	
Anode Flange	200°C
Ceramic-to-metal Seals	250°C
Maximum Dimensions:	
Height	8.75 inches
Diameter	7.5 inches
Net Weight	18 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION	30 KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000 volts
DC Plate Current	6.0	6.0 amps
DC Grid Voltage	—600	—800 volts
DC Grid Current	.66	.315 amps
Peak Positive Grid Voltage	440	360 volts
Driving Power	660	365 watts
Plate Input Power	42	60 kW
Plate Dissipation	12	18 kW
Plate Output Power	30	42 kW
Approximate Load Impedance	600	750 ohms

(Revised 3-1-67) © 1967 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER
PLATE-MODULATED
Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	20	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	—600	—820	volts
DC Plate Current	5.0	5.0	amps
DC Grid Current	600	600	mA
Driving Power	600	750	watts
Plate Output Power	17.8	27.5	kW

RADIO-FREQUENCY
LINEAR AMPLIFIER
Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
PLATE DISSIPATION	30	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Grid Voltage*	—250	—400	volts
Zero-Sig Plate Current	2.0	2.0	amps
Max-Sig DC Plate Current	6.0	6.0	amps
Max-Sig DC Grid Current	375	333	mA
Peak RF Grid Voltage	530	700	volts
Driving Power	200	240	watts
Plate Output Power	26.4	41	kW

*Adjust to give specified zero-signal dc plate current.

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament—The rated filament voltage for the 3CV30,000A3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation — The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation — The maximum plate input power rating is 60 kilowatts at 10,000 volts and 6.0 amperes dc. This rating applies for Class C amplifier or oscillator service and for Class AB applications. When used as a plate modulated rf amplifier, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

Special Application—If it is desired to operate this tube under conditions widely different from these given here, write to Power Grid Tube Marketing Department, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

MECHANICAL

Mounting — The 3CV30,000A3 must be mounted vertically, base up in an EIMAC BR-200 boiler. It is very important that the boiler tube assembly be mounted vertically, the water be maintained at the suggested level, and that the flange of the tube makes a vapor-tight seal against the rubber "O" ring and boiler.

Sockets—The EIMAC SK-1310 socket is available for use with the 3CV30,000A3. Filament and grid connection are made to this socket.

Cooling — Cooling is accomplished by immersion of the anode in a distilled water-filled BR-200 boiler. The energy dissipated at the anode causes the water to boil and be converted into steam. Steam is carried away by convection to the condenser where it is cooled and condenses into water. Condensate is then returned to the boiler.

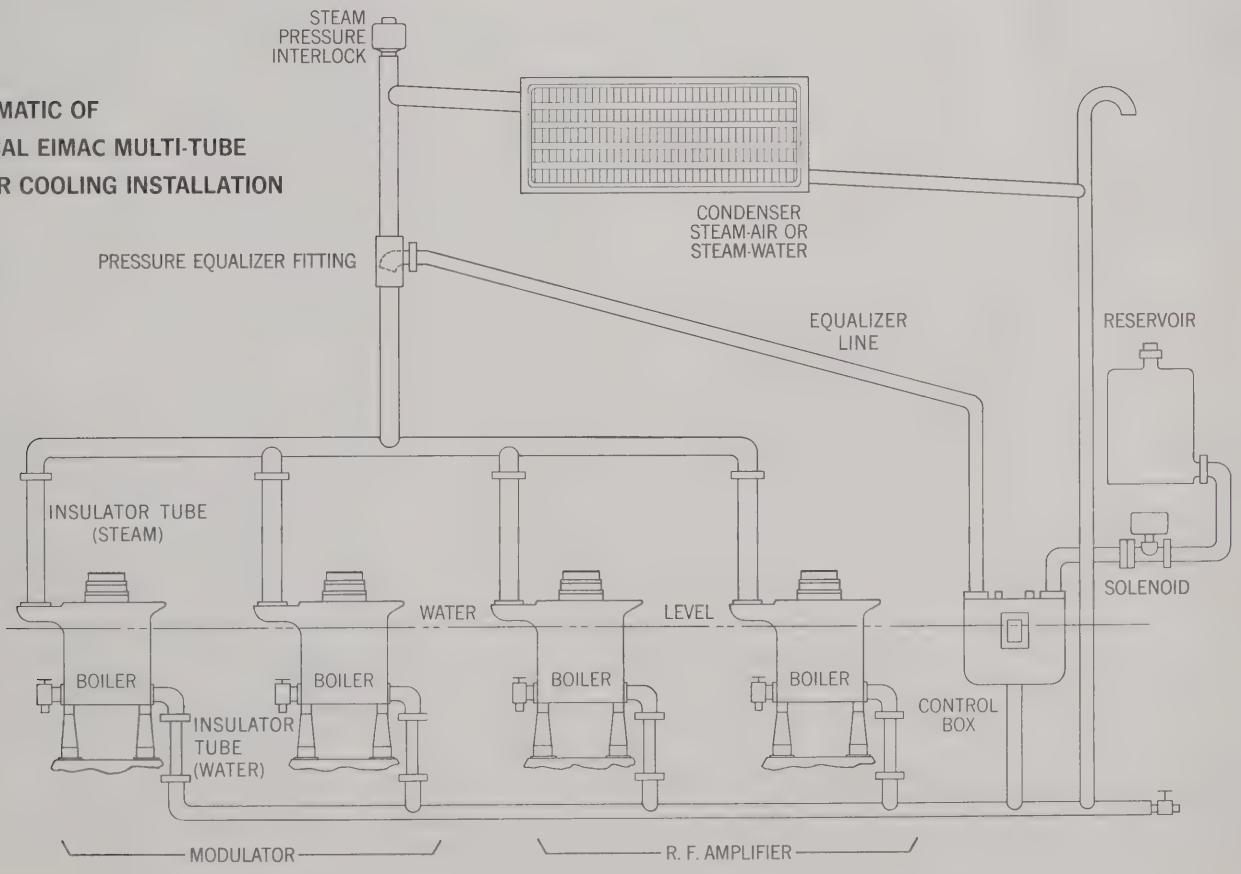
The boiling action maintains the anode surface temperature at approximately 100°C. In a properly designed system (such as the 3CV30,-000A3 and BR-200) it unlikely that anode surface temperature will ever exceed 125°C — well below the rated maximum for the tube — even at full plate dissipation levels.

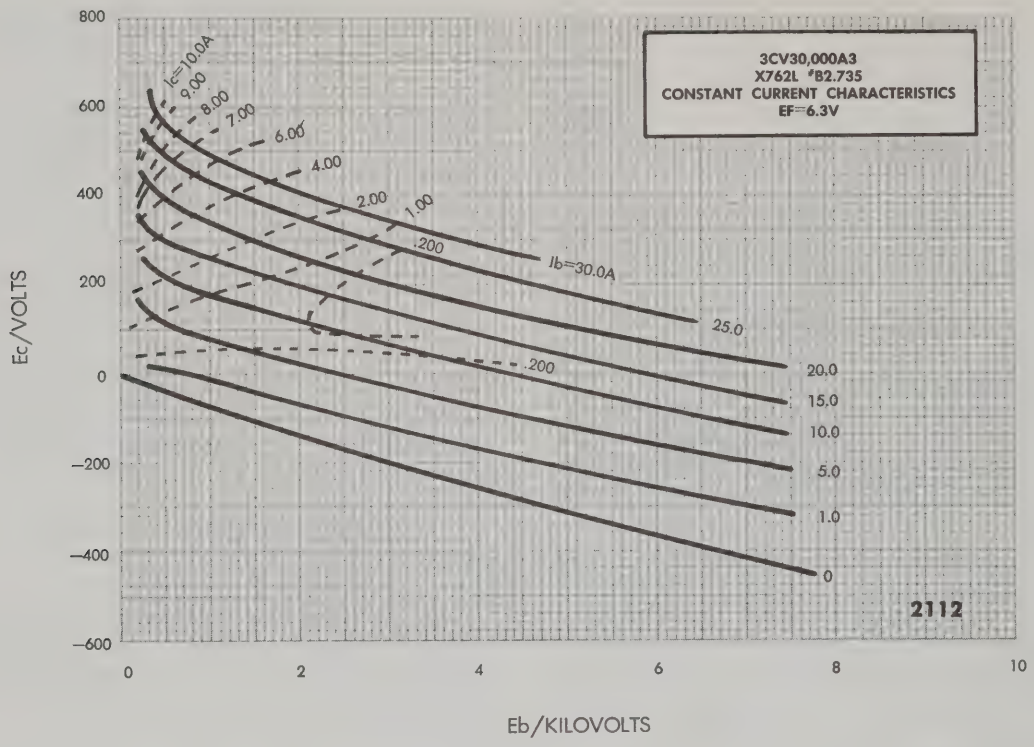
The water in the boiler must be maintained at a constant level, just below the top of the anode fins. This level is marked on the boiler. A recommended system for assuring constant water level is shown in the system diagram below. This system incorporates an EIMAC CB-202 Control Box to sense water level and a small reservoir to supply make-up water on demand. In the event of a drop in system water level, a switch is closed in the control box, energizing a solenoid water valve in the line from the reservoir. When the make-up water brings the system back to the proper level, the switch is opened, de-energizing the solenoid valve. A second switch in the CB-202 Control Box senses a lower, danger level and can be used to actuate an alarm or shut down the system.

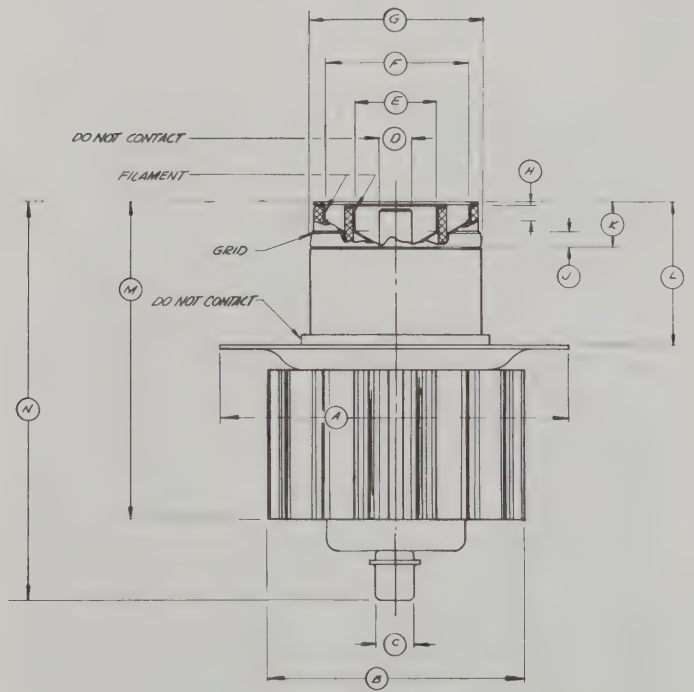
For reliable operation, it is essential that the Control Box be mounted so that the level sensed is the actual level in the boiler.

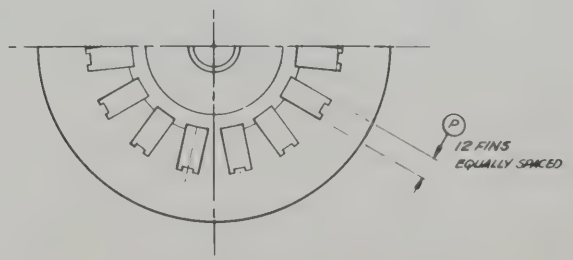
Separate cooling of the tube base is required and is accomplished by directing 100 CFM of cooling air into the base structure from the top of the socket.

SCHEMATIC OF TYPICAL EIMAC MULTI-TUBE VAPOR COOLING INSTALLATION









DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			7.750
B			5.812
C	.855	.895	
D	.720	.760	
E	1.896	1.936	
F	3.133	3.173	
G	3.792	3.832	
H	.188		
J	.188		
K	.986	1.050	
L			3.062
M	6.920	6.990	
N	8.250	8.750	
P			.510

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

3CW25,000A3

MEDIUM-MU

WATER-COOLED
POWER TRIODE

The EIMAC 3CW25,000A3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is rated at 25 kilowatts of plate dissipation with low water flow and pressure drop.

Full input of 60 kilowatts is permissable up to 100 MHz. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe applications.

It is also recommended as a grounded grid FM amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		volts
Current	152		172	amperes
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF
Frequency for Maximum Ratings				100 MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1300
Operating Position	Vertical, base up or down
Cooling	Water and Forced air
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Maximum Dimensions:	
Height	9.4 inches
Diameter	5.0 inches
Net Weight	12 pounds

(Revised 3-1-67) © 1967 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION	25 KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Plate Current	6.0	6.0	amps
DC Grid Voltage	—600	—800	volts
DC Grid Current	.66	.315	amps
Peak Positive Grid Voltage	440	360	volts
Driving Power	660	365	watts
Plate Input Power	42	60	kW
Plate Dissipation	12	18	kW
Plate Output Power	30	42	kW
Approximate Load Impedance	600	750	ohms

RADIO-FREQUENCY POWER AMPLIFIER PLATE-MODULATED

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	16.5 KW
GRID DISSIPATION	500 WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	—600	—820	volts
DC Plate Current	5.0	5.0	amps
DC Grid Current	600	600	mA
Driving Power	600	750	watts
Plate Output Power	17.8	27.5	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
PLATE DISSIPATION	25 KW
GRID DISSIPATION	500 WATTS

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Grid Voltage*	—250	—400	volts
Zero-Signal Plate Current	2.0	2.0	amps
Max-Signal DC Plate Current	6.0	6.0	amps
Max-Signal DC Grid Current	375	333	mA
Peak RF Grid Voltage	530	700	volts
Driving Power	200	240	watts
Plate Output Power	26.4	41	kW

*Adjust to give specified zero-signal dc plate current.

NOTE: "TYPICAL OPERATION" DATA ARE OBTAINED BY CALCULATION FROM PUBLISHED CHARACTERISTIC CURVES. NO ALLOWANCE FOR CIRCUIT LOSSES HAS BEEN MADE

APPLICATION

ELECTRICAL

Filament — The rated filament voltage for the 3CW25,000A3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation — The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation — The maximum plate input power rating is 60 kilowatts at 10,000 volts and 6.0 amperes dc. This rating applies for Class C amplifier or oscillator service and for Class AB applications. When used as a plate modulated rf amplifier, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation — The 3CW25,000A3 is usable to 140 MHz. At this frequency, plate voltage must be reduced to 7000 volts in class A, B or C service. For plate-modulated applications at 140 MHz plate voltage is reduced to 5500 volts.

APPLICATION

Mounting — The 3CW25,000A3 must be mounted vertically, either base up or down. Where the tube is installed in a base up position, it is suggested that any clamping pressure or rf contact be made only in the area shown as "V" on the outline drawing.

Socket — The EIMAC SK-1300 socket is used with the 3CW25,000A3 for making connections to the filament and grid. Where the socket is to be removable — as in base-up operation — the SK-1310 should be used.

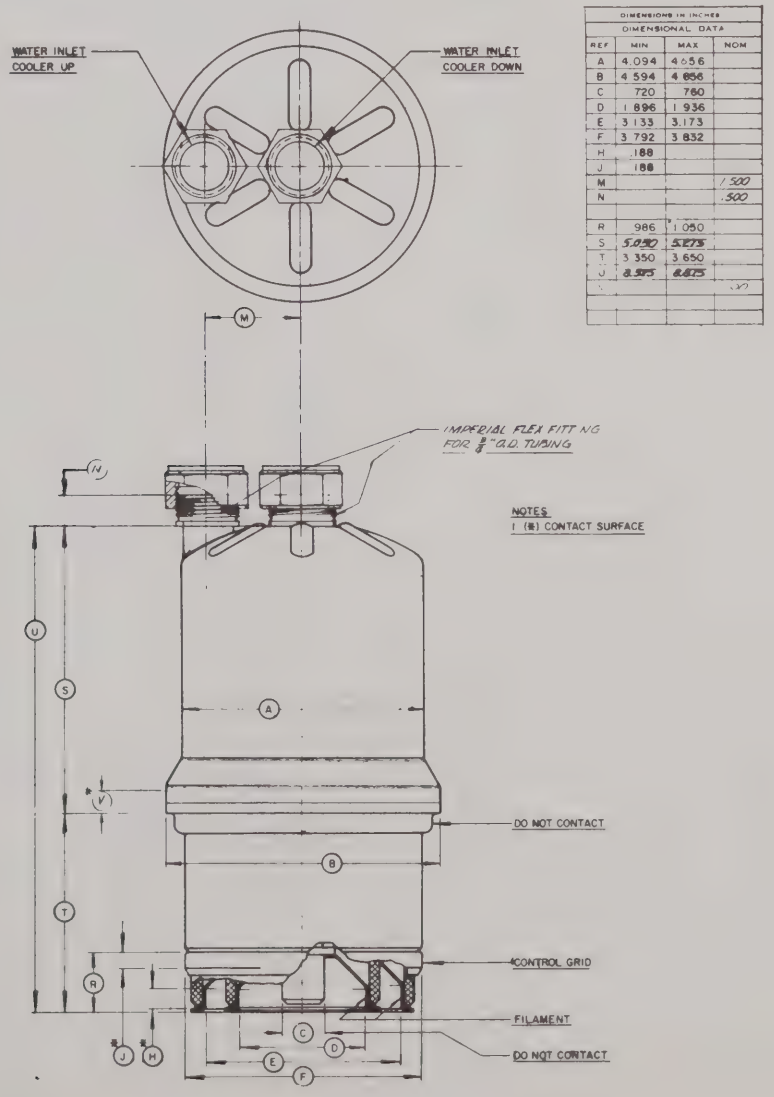
Cooling — Anode cooling is accomplished by circulating water through the integral anode — water jacket. With the tube in the anode-up position the water inlet is the outer water fitting and the outlet will be the center water fitting. When the tube is mounted base up, these are reversed.

The table shown lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, inlet water temperature must be limited to 60°C or below, outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi.

MINIMUM WATER-COOLING REQUIREMENT		
Plate Dissipation (kW)	Water Flow (GPM)	Pressure Drop (PSI)
10	6	0.2
15	9	0.4
20	12	0.7
25	15	1.1

Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 100 cfm of cooling air directed into the base structure, through the socket will generally satisfy this requirement.

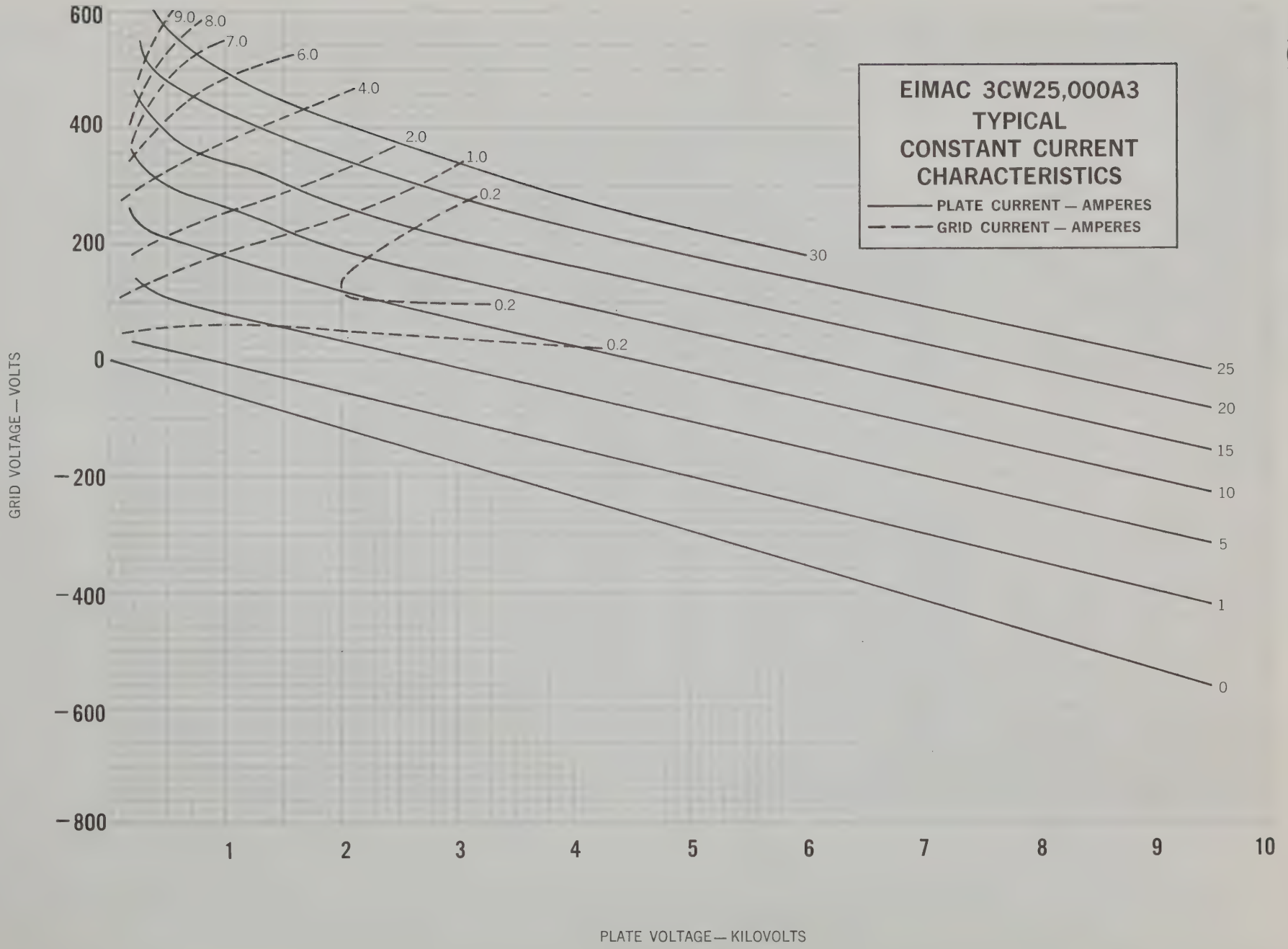
Special Application — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.



DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF	MIN	MAX	NOM
A	4.094	4.656	
B	4.594	4.656	
C	.720	.780	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
H	.188		
J	.188		
M			1.500
N			.500
R	.986	1.050	
S	5.090	5.275	
T	3.350	3.650	
U	8.595	8.875	
V			.250

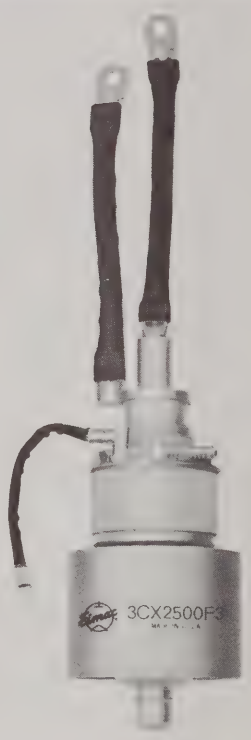

EIMAC 3CW25,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
30
25
20
15
10
5
1
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE — KILOVOLTS

EIMAC

A Division of Varian Associates

8251
3CX2500F3

MEDIUM MU TRIODE



The EIMAC 3CX2500F3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500F3 is an exact replacement for the EIMAC 3X2500F3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube is equipped with flexible filament and grid leads which simplify socketing and equipment design for industrial and communication frequencies below 30 megahertz.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	48		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	pF
Grid-Filament	29.2		40.2	pF
Plate-Filament	0.6		1.2	pF
Tranconductance (Ib=830 ma., Eb=3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			30	MHz

MECHANICAL

Base	See outline drawing
Mounting	Vertical, base down or up
Maximum Anode Core and Seal Temperatures	250°C
Cooling	Forced Air
Maximum Over-all Dimensions:	
Length (Does not include filament connectors)	8.6 inches
Diameter	4.16 inches
Length of filament Connectors (Approximate)	9.5 inches
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier, Class-C FM or Telegraphy (Key-down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	2500 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	4000	5000	6000	volts
DC Plate Current	2.5	2.5	2.08	amps
DC Grid Voltage	—300	—450	—500	volts
DC Grid Current	245	265	180	ma
Peak RF Grid Input Voltage*	580	750	765	volts
Driving Power*	142	197	136	watts
Grid Dissipation*	68	78	46	watts
Plate Input Power	10,000	12,500	12,500	watts
Plate Dissipation	2500	2500	2500	watts
Plate Output Power	7500	10,000	10,000	watts

*Approximate values.

(Revised 3-1-67) © 1967 Varian

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier, Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500	VOLTS
DC PLATE CURRENT	2.0	AMPS
PLATE DISSIPATION	1670	VOLTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	4000	4500	5000	volts
DC Plate Current	1.67	1.47	1.25	amps
DC Grid Voltage	—450	—500	—550	volts
DC Grid Current*	180	140	150	ma
Peak RF Grid Input Voltage*	685	715	760	volts
Driving Power*	125	100	115	watts
Grid Dissipation*	43	30	32	watts
Plate Input Power	6670	6615	6250	watts
Plate Dissipation	1670	1315	950	watts
Plate Output Power	5000	5300	5300	watts

*Approximate values.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	2500	WATTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage[1]	—150	—190	—240	volts
Zero-Signal DC Plate Current	0.6	0.5	0.4	amps
Max-Signal DC Plate Current	4.0	3.2	3.0	amps
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390	volts
Max-Signal Peak Driving Power*	340	230	225	watts
Max-Signal Nominal Driving Power*	170	115	113	watts
Max-Signal Plate Output Power	11,000	11,000	13,000	watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDNG THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Cooling—Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 MHz, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Anode-to-Base Air Flow[1]

	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air Flow

	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1] When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

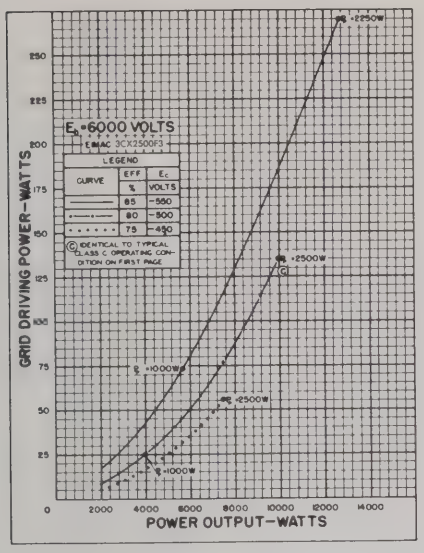
Filament Voltage — The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts. Tube life may be extended by operation at the lower end of this range.

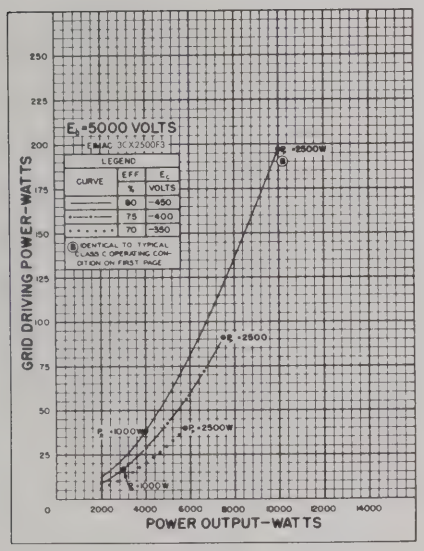
Bias Voltage — There is little advantage in using bias voltages in excess of those given under "TYPICAL OPERATION" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

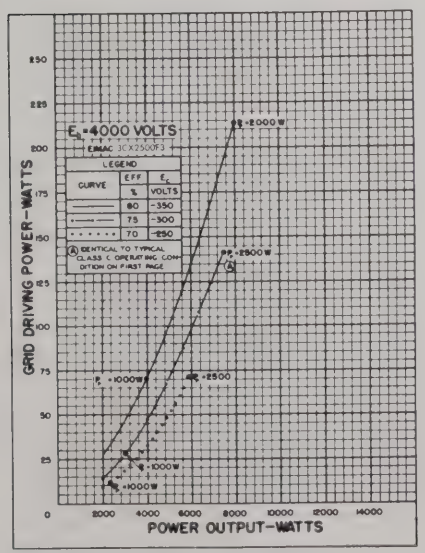
Plate Voltage — The plate-supply voltage for the 3CX2500F3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "TYPICAL OPERATION" for the power output desired.

Grid Dissipation — The power dissipated by the grid of the 3CX2500F3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

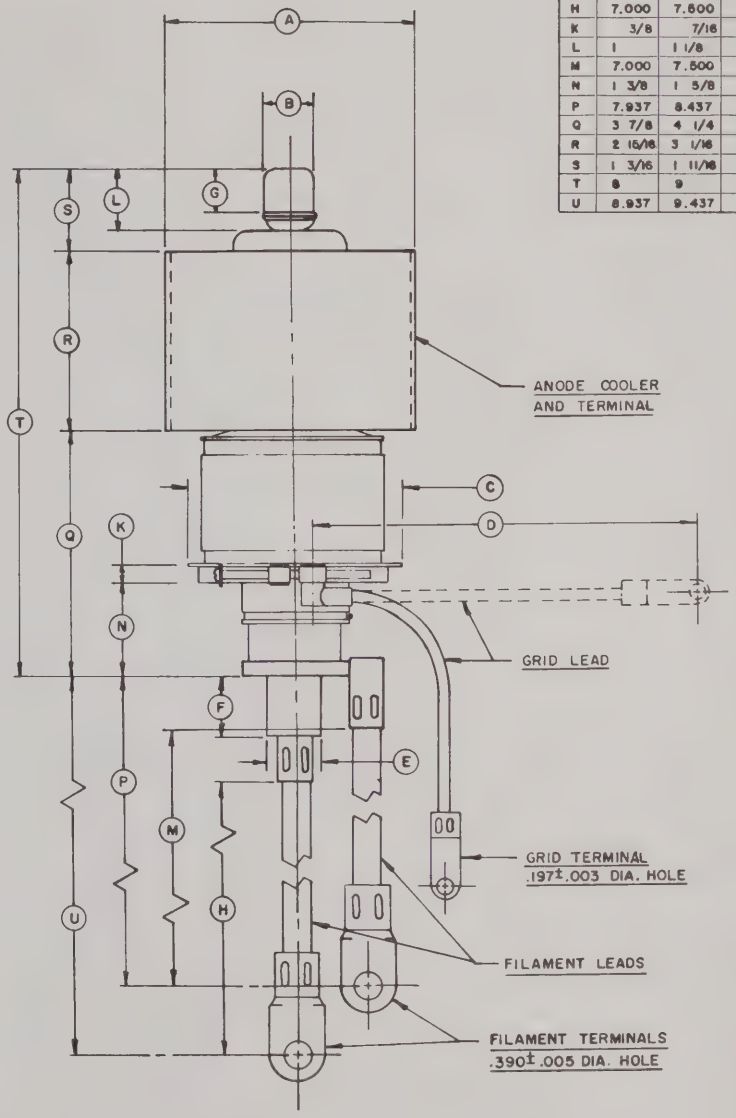
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





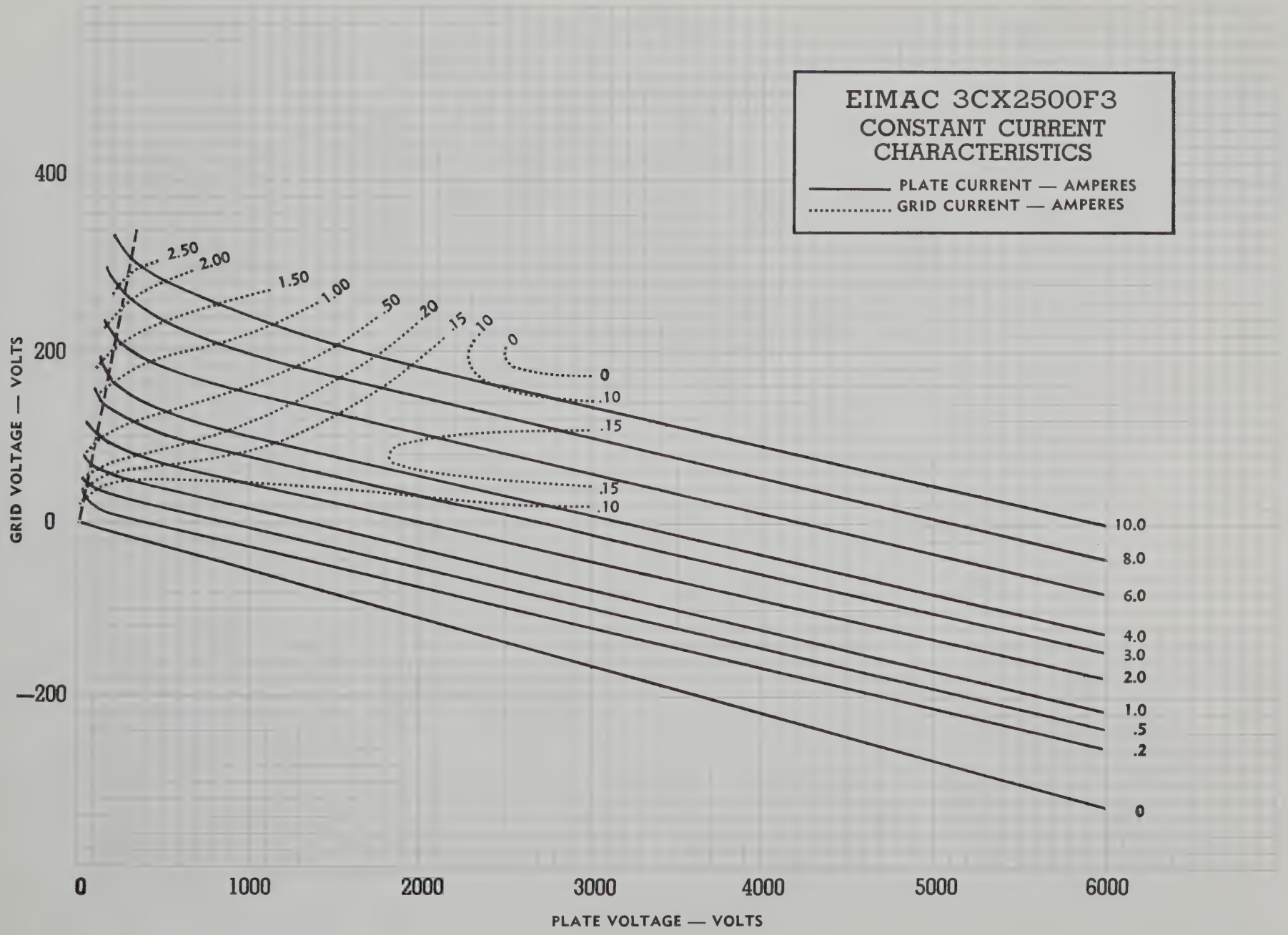


DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	11/16	13/16	
H	7.000	7.500	
K	3/8	7/16	
L	1	1 1/8	
M	7.000	7.500	
N	1 3/8	1 5/8	
P	7.937	8.437	
Q	3 7/8	4 1/4	
R	2 15/16	3 1/16	
S	1 3/16	1 11/16	
T	8	9	
U	8.937	9.437	



DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4,000, 5000 and 6000 volts respectively.


EIMAC 3CX2500F3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CX1500B

RADIAL BEAM POWER TETRODE

JEDEC DESIGNATION

8660

The EIMAC 4CX1500B is ceramic and metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 1500 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 4CX1500B especially suitable for radio-frequency and audio-frequency linear amplifier service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	9.0		11.0	amperes
Transconductance:				
(I_b=0.5 amperes, E_{c2}=225 volts)		30,000		umhos

Direct Interelectrode Capacitances, Grounded Cathode: *	Min.	Nom.	Max.	
Input	75		88	pF
Output	10.8		12.8	pF
Feedback			.03	pF
Direct Interelectrode Capacitances, Grounded Grid and Screen: *				
Input		38		pF
Output		12		pF
Feedback			0.005	pF

*In Shielded Fixture

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (Approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	900 AMP
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	12 WATTS
CONTROL GRID DISSIPATION	1 WATT

*Adjust to the specified Zero-Signal Plate Current.
**The driving power specified includes the power dissipated in a 1000 ohm swamping resistor between the control grid and the cathode.
***The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies below 30 MHz)

Class AB_2, Grid Driven, Peak Envelope or Modulation Crest Conditions

DC Plate Voltage	2500	2750	2900	Volts
DC Screen Voltage	225	225	225	Volts
DC Grid Voltage*	—34	—34	—34	Volts
Zero-Signal DC Plate Current	300	300	300	mA
Single-Tone DC Plate Current	720	755	710	mA
Two-Tone DC Plate Current	530	555	542	mA
Single-Tone DC Grid Current	1.3	0.95	0.53	mA
Two-Tone DC Grid Current	0.06	0.20	0.06	mA
Single-Tone DC Screen Current	—7	—14	—15	mA
Two-Tone DC Screen Current	—11	—11	—11	mA
Peak RF Grid Voltage	46	45	41	Volts
Driving Power**	1.5	1.5	1.5	Watts
Useful Output Power	900	1100	1100	Watts
Resonant Load Impedance	1900	1900	2200	Ohms
Intermodulation Distortion Products***— 3rd order	—38	—40	—43	db
5th order	—47	—48	—47	db

(Revised 4-1-67) © 1966, 1967 by Varian

Printed in U.S.A.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	900 AMP
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	1.0 WATTS

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Sinusoidal wave, 2 tubes unless noted)

DC Plate Voltage	2000	2500	2900	Volts
DC Screen Voltage	325	325	325	Volts
DC Grid Voltage**	—60	—60	—60	Volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.68	1.69	1.69	Amps
Zero-Signal DC Screen Current*	—30	—25	—20	mA
Max.-Signal DC Screen Current*	—27	—33	—32	mA
Effective Load, Plate to Plate	1948	2715	3333	Ohms
Driving Power	0	0	0	Watts
Max.-Signal Plate Output Power	1604	2258	2774	Watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

Cooling — The maximum temperature rating for the anode core of the 4CX1500B is 250°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-to-metal seals to below 250°C. Air flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). Tube mounted in recommended socket and chimney.

	Sea Level		10,000 feet	
Plate Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1000	18	.23	24	.31
1500	34	.60	45	.80

*Since the power dissipated by the heater represents about 60 watts and since grid plus screen dissipation can, under some conditions, represent another 13 watts, allowance has been made in preparing this tabulation for an additional 73 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

Heater — The rated heater voltage for the 4CX1500B is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Intermodulation Distortion — The Radio Frequency Linear Amplifier operating conditions including the distortion data are the results of actual operation in a neutralized grid-driven amplifier. Plots of IM distortion versus power output under two-tone conditions, as a function of zero-signal plate current, are included to illustrate the effect of this parameter upon distortion. Because the 4CX1500B has very low grid interception it is possible to drive the grid positive without any adverse effects upon the distortion level or upon the driver. Class AB_2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX1500B be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.

Control-Grid Operation — The control grid dissipation rating of the 4CX1500B is 1 watt. The design features which make the 4CX1500B such an extremely linear tube also contribute to very low grid interception. It will be found that the grid will be driven into the positive grid region in the typical operation of the tube. The grid current will usually be less than 1.0 milliampere.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1500B and, under some operating conditions, indicated negative screen currents in the order of 35 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1500B is 12 watts and

the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

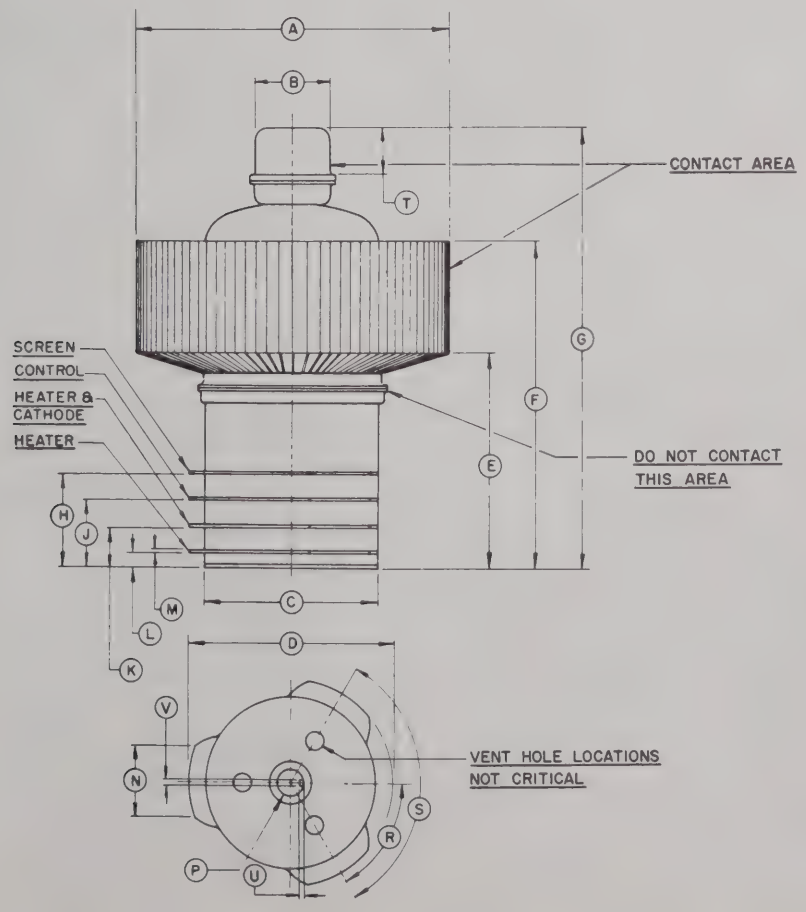
The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

Plate Operation — The maximum rated plate dissipation power is 1500 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

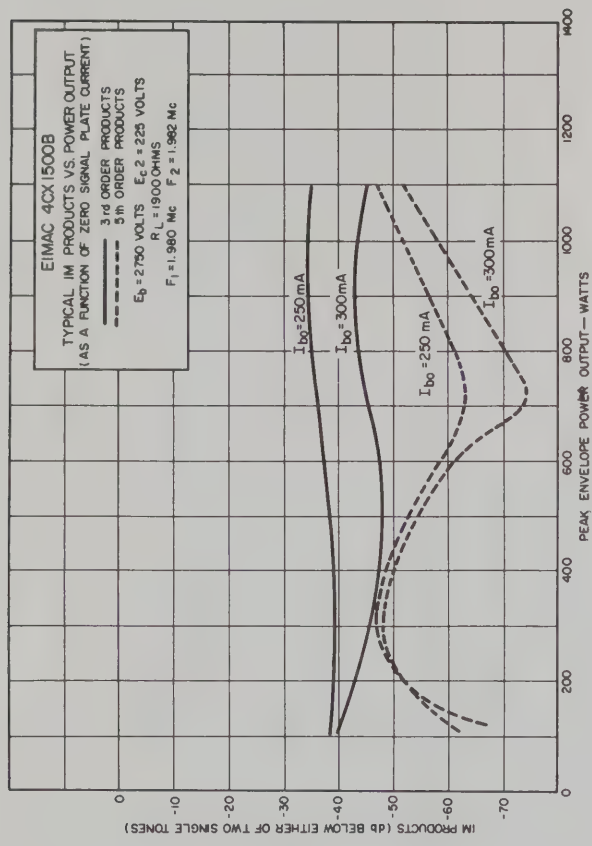
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

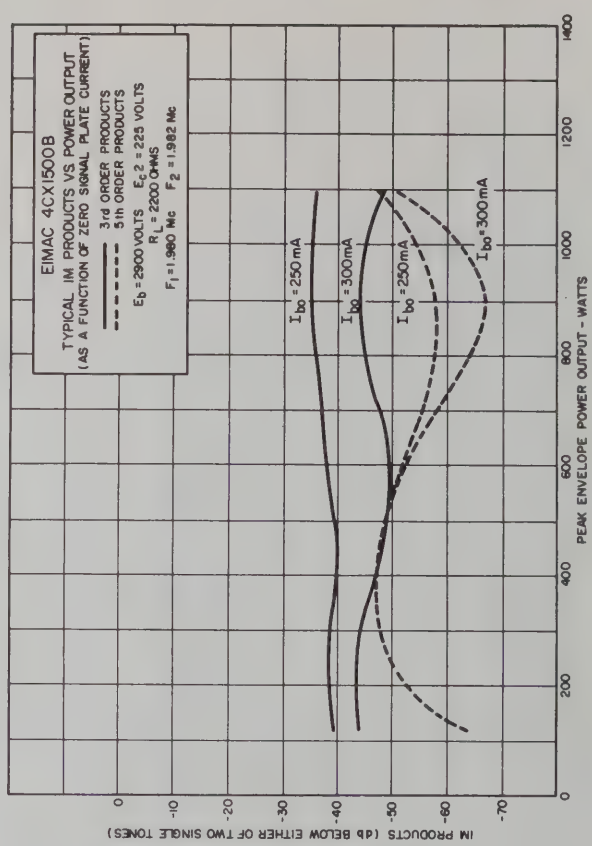
Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

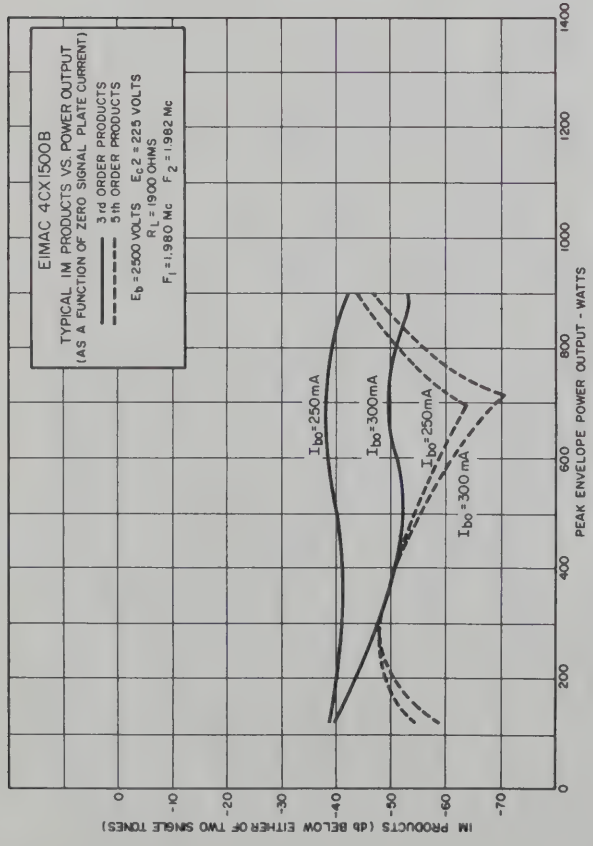
Special Applications — If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Product Manager, EIMAC Division of Varian Associates, San Carlos, California, for information and recommendations.

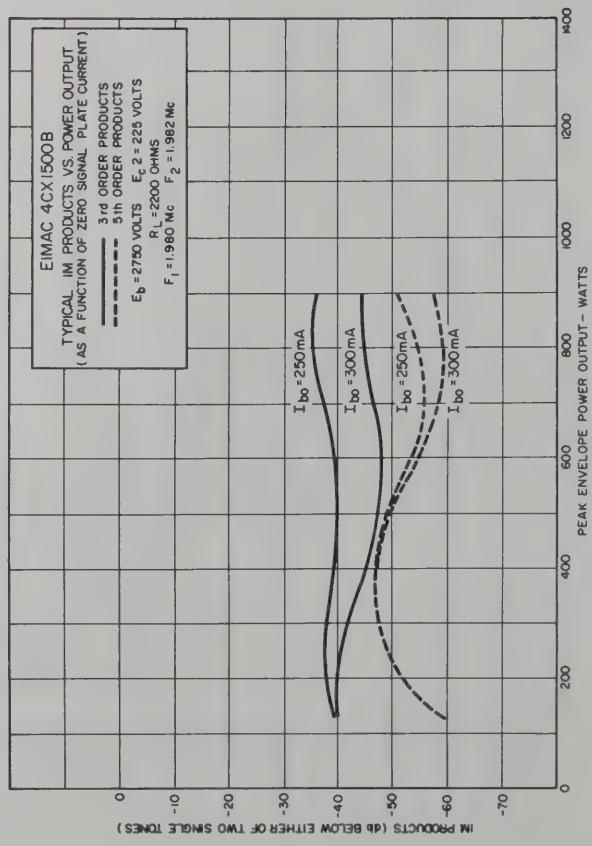


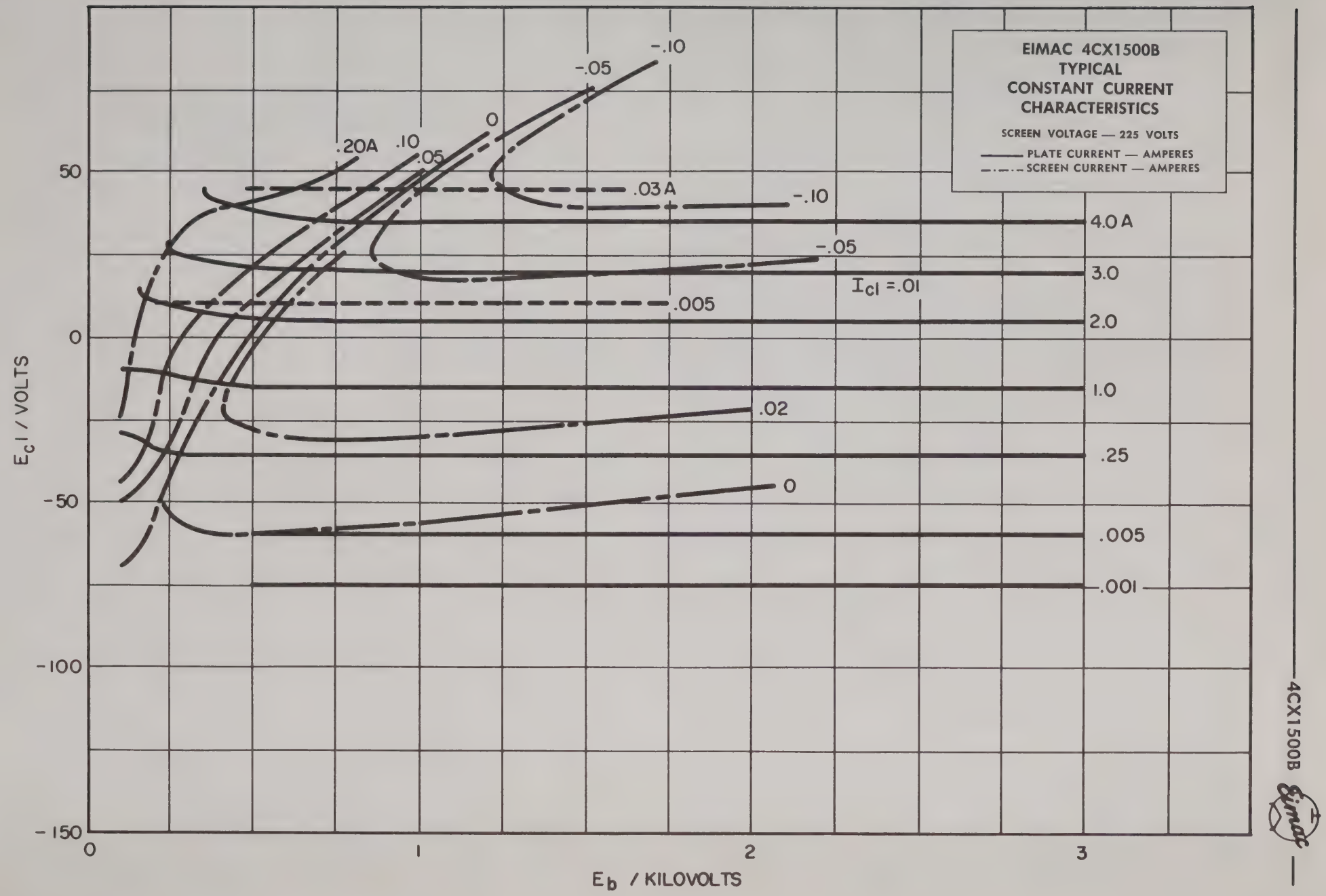
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.

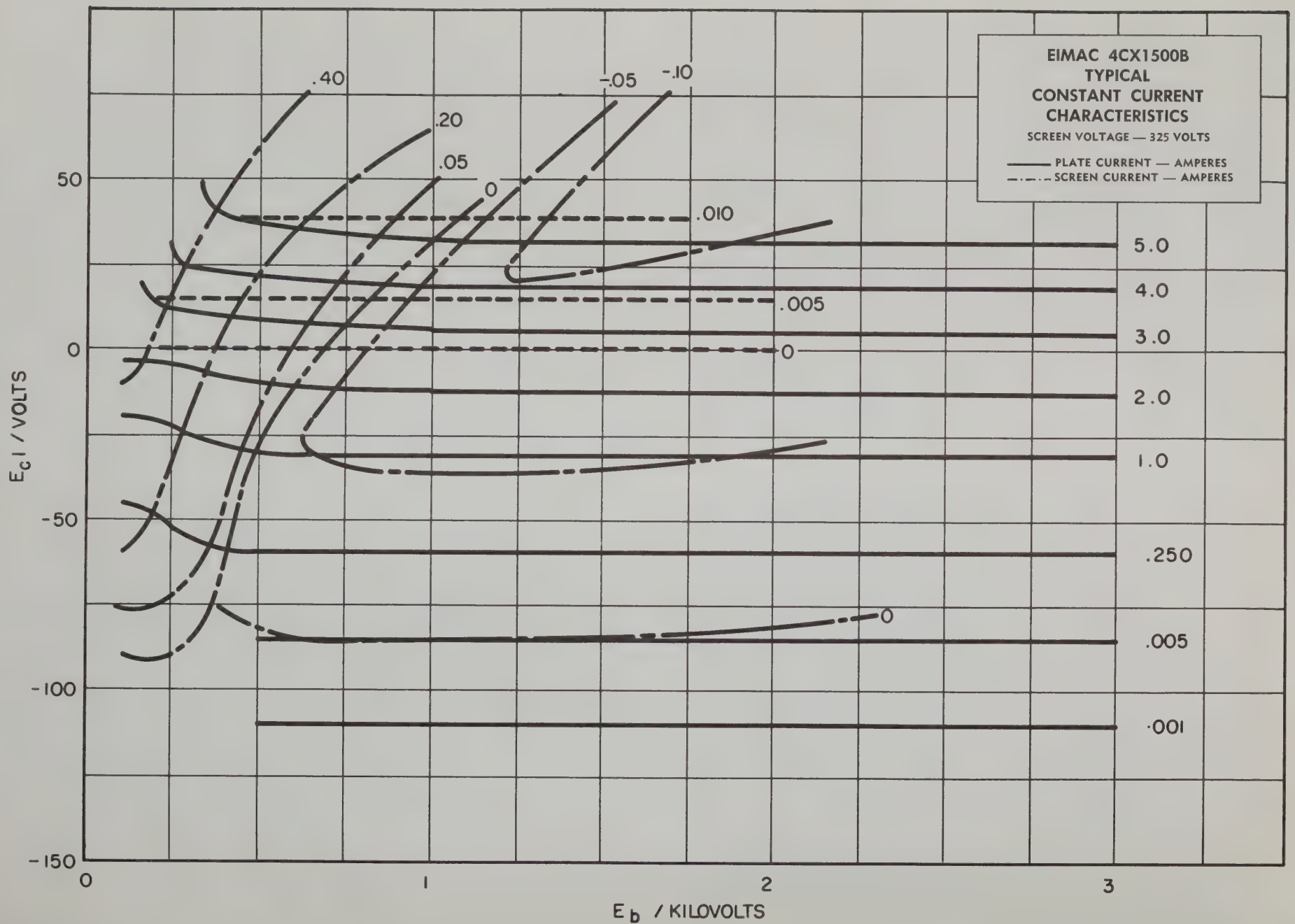

EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250 mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT— WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2900 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250 mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2500 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300 mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS

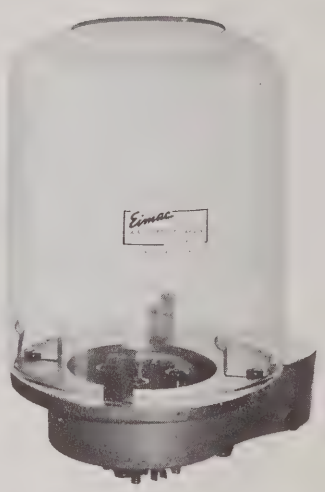

EIMAC 4CX1500B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 225 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
-.10
-.05
0
.20A
.10
.05
.03A
-.10
4.0A
-.05
3.0
I_{c1} =.01
.005
2.0
1.0
.02
.25
0
.005
.001
50
0
-50
-100
-150
E_{c1} / VOLTS
0
1
2
3
E_b / KILOVOLTS
4CX1500B
Eimac


EIMAC 4CX1500B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
.40
.20
.05
0
-.05
-.10
.010
.005
0
5.0
4.0
3.0
2.0
1.0
.250
.005
·001
0
50
0
-50
-100
-150
0
1
2
3
Ec1 / VOLTS
Eb / KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-500

AIR-SYSTEM SOCKET AND CHIMNEY



The SK-500 Air-System Socket is the recommended socket for use with the 4-1000A tetrode, and it may be used as well with any other tubes having the same physical dimensions. The SK-500 provides efficient connection between the tube and its external circuits, acts as a firm mechanical support for the tube, and controls the flow of cooling air around the tube envelope.

The SK-500 Air-System Socket consists of a cast aluminum body which supports the electrical insulation for the terminals and acts as an air-duct to guide the air flow into the base of the tube. The air passes through the base of the tube and is guided past the tube envelope and plate seal by the glass Air Chimney, SK-506.

Most applications of the SK-500 Air-System Socket require the use of the SK-506 Air Chimney to guide the air over the envelope of the tube and past the plate seal. The SK-506 Air Chimney may be omitted only in the few special cases where other definite provisions for cooling the tube envelope and plate seal have been made.

The electrical insulation for the connecting jacks and their terminals is a disk of low-loss insulating material, resting on a shoulder turned into the bottom of the socket body. The insulating disk is held in place by four machine screws which act as clamps. The design permits the insulation and terminal assembly to be rotated to any convenient direction and clamped firmly in place, so no compromise with wiring requirements will have to be made when the socket is installed.

An air blower must be connected to the socket air-inlet. This can be done by means of a duct terminating in a cylindrical fitting of two inches O.D., or the chassis may be enclosed and connected to the blower. In either case the pressure drops and corresponding flow-rates will depend upon the tube type, power level, operating frequency and ambient conditions, and must be obtained from the data sheet for the specific tube type being used.

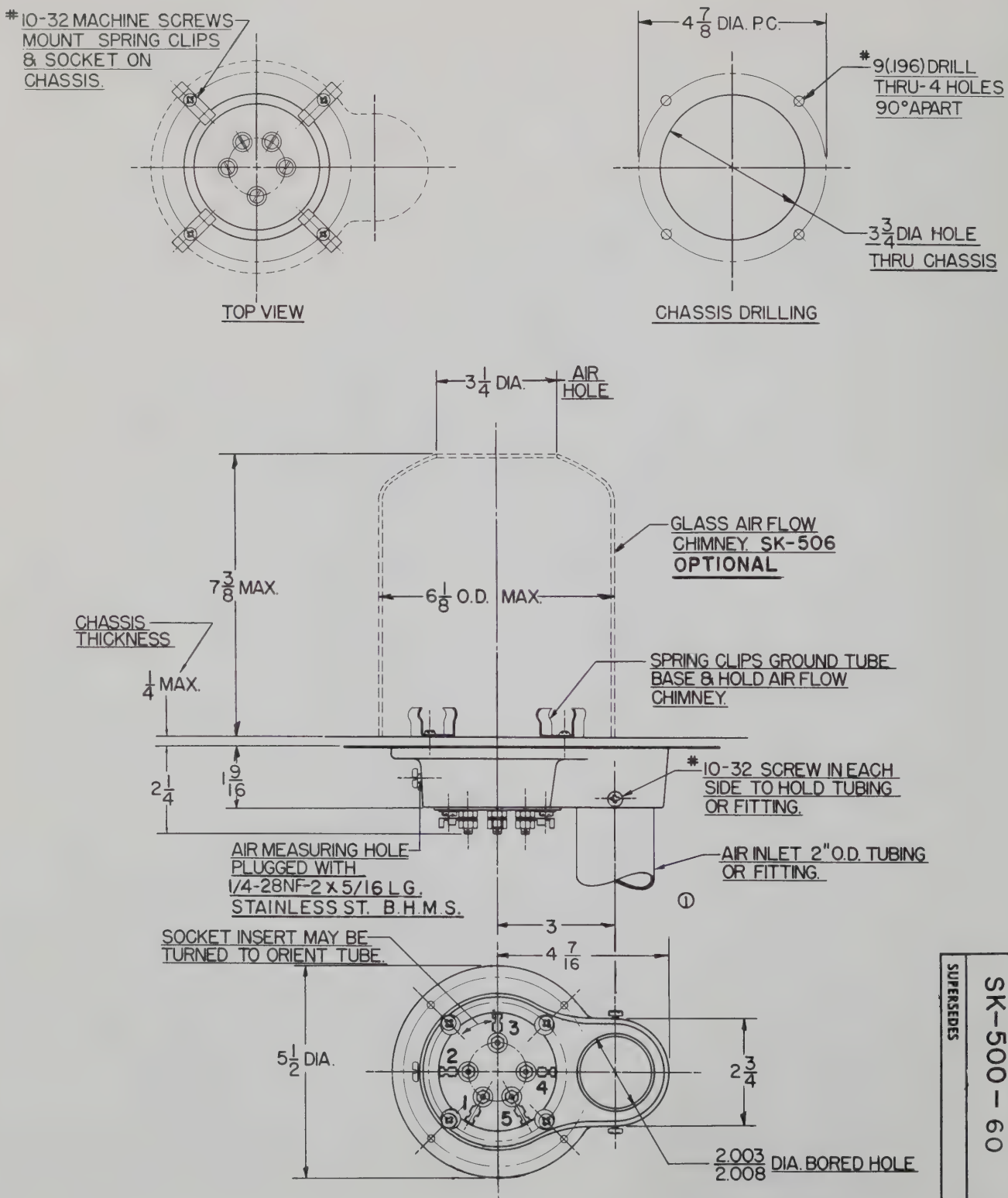
Socket air pressure can be measured conveniently by a manometer arranged to indicate the pressure difference between the air in the socket and the air in its surroundings. To facilitate and standardize this measurement, ¼-28-threaded hole is provided in the wall of the socket body opposite the air inlet. A probe or fitting can be screwed into this hole for connection to a manometer; it should be screwed into the socket until its end is flush with the inner wall of the socket base. It should not be permitted to protrude inside the inner surface of the socket wall.

The SK-500 Air-System Socket is designed for under-chassis mounting and requires a 3-¾-inch diameter hole through the chassis deck. The socket is fastened in place by four No. 10 32 machine screws, running in tapped holes in the cast aluminum body. These four screws also hold four small, double clips, which serve to ground the metal base of the tube and to hold the SK-506 Air Chimney in place.

When a tube is inserted in the socket, the five pins on the tube are engaged by five self-aligning pin-jacks in the socket. The connecting leads to the socket must be sufficiently flexible to permit free movement of the pin-jacks, or the self-aligning feature may be impaired.

(Revised 3-15-67) © 1961, 1967 by Varian

Printed in U.S.A.



REFER TO TUBE DATA SHEET FOR TERMINAL DESIGNATIONS

CODE IDENT.	PART NO.
06980	SK-500

SUPERSEDES

DRWG. No. SK-500-60

CHANGE 6

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-620
SK-620A
AIR-SYSTEM SOCKET

The EIMAC SK-620 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-626 Air Chimney or a fiberglass-reinforced silicone resin SK-636 Air Chimney are also available and are recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-620 Air-System Socket is humidity and salt-spray resistant. The SK-620A is an improved SK-620 which includes a slightly modified screen by-pass capacitor sealed with an improved encapsulating material to insure reliable performance under high humidity or moisture conditions.



BASE CONNECTIONS

The SK-620 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance; these terminal lugs are insulated from the socket body.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low-inductance screen by-pass capacitor, 1100 pF ±20%, which provides a short radio-frequency path to ground. The silvered-mica dielectric, encapsulated in epoxy resin, is humidity and salt-spray resistant. The sockets are hi-voltage tested at 2000 volts dc and are rated for use at 1000 volts dc.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT . . . . . 4 Ounces

INSTALLATION

The SK-620 and SK-620A Air-System Sockets can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-¼″ diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-⅝″ diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

TUBE EXTRACTOR

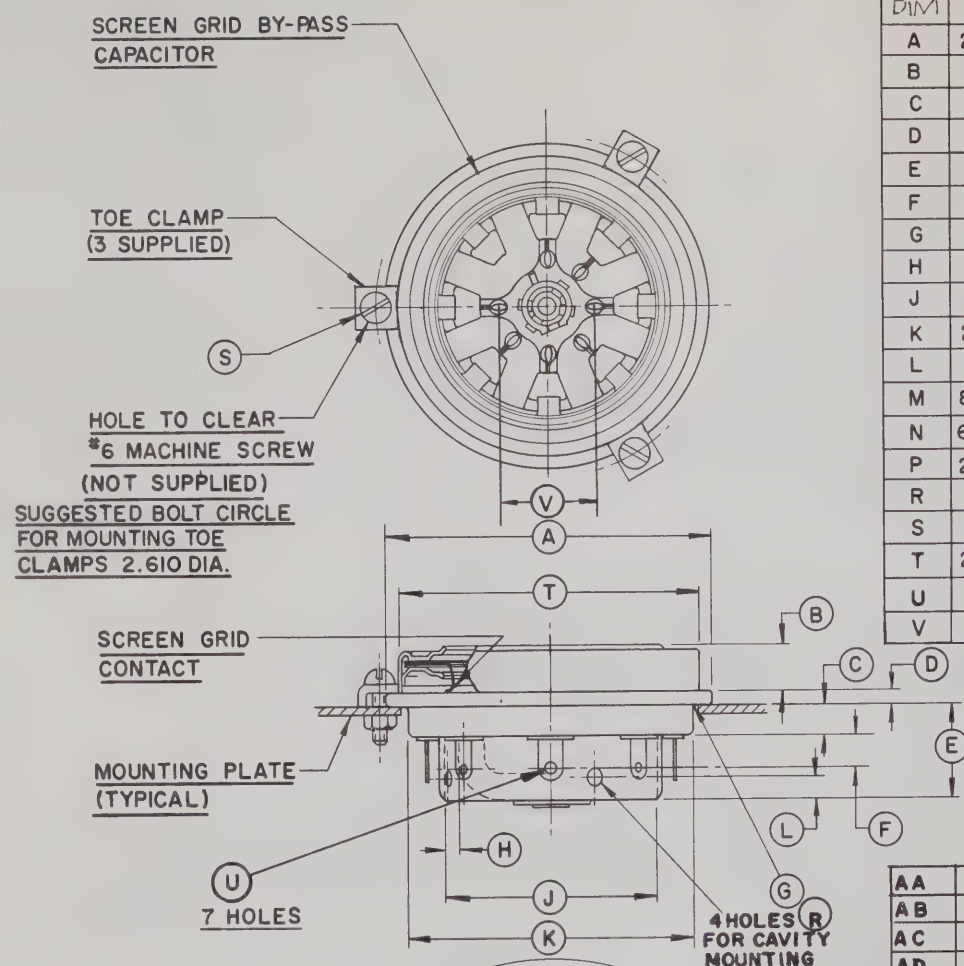
The SK-604 is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-620 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-620 AND SK620A AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

(Revised 3-15-67) © 1961, 1967 by Varian

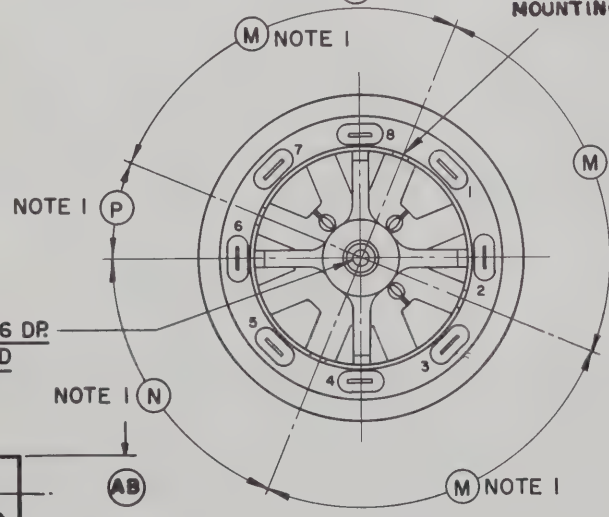
Printed in U.S.A.



DIMENSION DATA			
DIM	MIN.	MAX.	REF
A	2.438 O.D.	2.498 O.D.	
B	.348	.388	
C	.203	.235	
D	.105	.145	
E	.700	.740	
F			.250
G		.031 R.	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE 1	91° NOTE 1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T	2.285 O.D.	2.305 O.D.	
U			.090 DIA
V			.687 DIA.

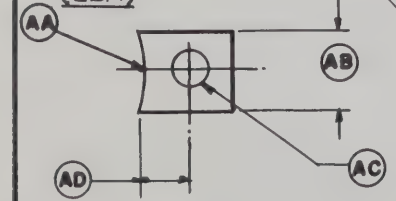
NOTE 4: REF DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.

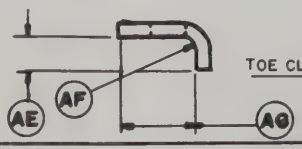
AA	1.230R	1.270R	
AB	.292	.332	
AC	.142DIA.	.146DIA.	
AD	.136	.176	
AE	.105	.145	
AF		.062R	
AG	.261	.301	



BOTTOM VIEW

#6-32 NC 2x3/16 DP. CONTROL GRID CONNECTION (REF.)





TOE CLAMP DETAIL

CONNECTIONS
NO. 1 SCREEN GRID
NO. 2 CATHODE
NO. 3 HEATER
NO. 4 CATHODE
NO. 5 NO CONNECTION
NO. 6 CATHODE
NO. 7 HEATER
NO. 8 CATHODE

NOTE:
1. TOLERANCES ARE NOT CUMULATIVE.
2. WORD "EIMAC" IN SOCKET IDENTIFICATION LABEL IS LOCATED (APPROX) NEXT TO PIN NO. 5.
3. CAPACITANCE 1100 MMFD ± 20% VOLTAGE 2000VDC-TEST, 1000WVDC

SUPERSEDES

DRWG. No. SK-620-60

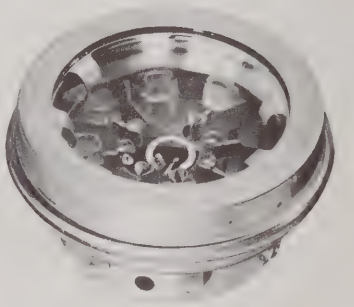
CHANGE 13

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-630
SK-630A
AIR-SYSTEM SOCKET

The EIMAC SK-630 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-626 Air Chimney or a fiberglass-reinforced silicone resin SK-636 Air Chimney are also available and are recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-630 Air-System Socket is humidity and salt-spray resistant. The SK-630A is an improved SK-630 which includes a slightly modified screen by-pass capacitor sealed with an improved encapsulating material to insure reliable performance under high humidity or moisture conditions.



BASE CONNECTIONS

The SK-630 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are connected directly to the metal shell of the socket and will automatically be grounded when the socket is mounted to a metal chassis.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low-inductance screen by-pass capacitor, 1100 pF ±20%, which provides a short radio-frequency path to ground. The silvered-mica dielectric, encapsulated in epoxy resin, is humidity and salt-spray resistant. The sockets are hi-voltage breakdown tested at 2000 volts dc and are rated for use at 1000 volts dc.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT . . . . . 4 Ounces

INSTALLATION

The SK-630 and SK-630A Air-System Socket can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-¼″ diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-⅝″ diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

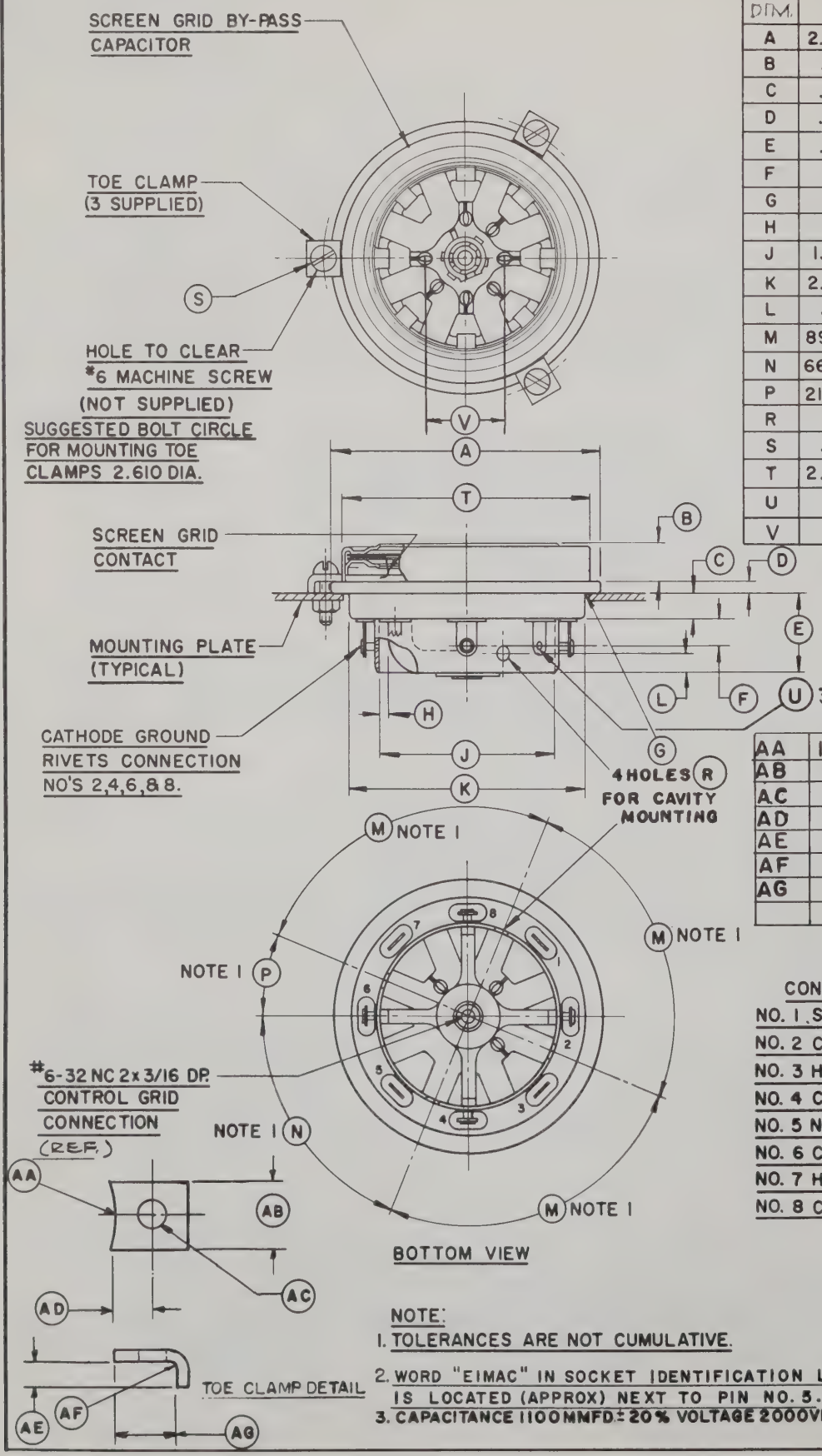
TUBE EXTRACTOR

The SK-604 is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-630 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-630 AND SK-630A AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

(Revised 3-15-67) © 1961, 1967 by Varian Printed in U.S.A.



DIMENSION DATA			
DIM.	MIN.	MAX.	REF.
A	2.438 O.D.	2.498 O.D.	
B	.348	.388	
C	.203	.235	
D	.105	.145	
E	.700	.740	
F			.250
G		.031 R.	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE 1	91° NOTE 1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T	2.285 O.D.	2.305 O.D.	
U			.090 DIA
V			.687 DIA.
AA	1.230 R	1.270 R	
AB	.292	.332	
AC	.142 DIA.	.146 DIA.	
AD	.136	.176	
AE	.105	.145	
AF		.062 R	
AG	.261	.301	

NOTE 4: REF. DIMS ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.

CONNECTIONS
NO. 1 SCREEN GRID
NO. 2 CATHODE
NO. 3 HEATER
NO. 4 CATHODE
NO. 5 NO CONNECTION
NO. 6 CATHODE
NO. 7 HEATER
NO. 8 CATHODE

NOTE:
1. TOLERANCES ARE NOT CUMULATIVE.
2. WORD "EIMAC" IN SOCKET IDENTIFICATION LABEL IS LOCATED (APPROX) NEXT TO PIN NO. 5.
3. CAPACITANCE 1100 MMFD. ± 20% VOLTAGE 2000 VDC TEST, 1000 W VDC

SUPERSEDES

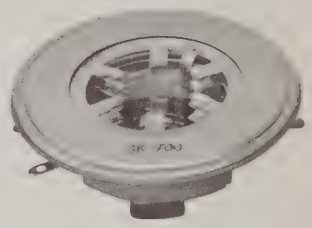
DRWG. No. SK-630-60

CHANGE 0

EIMAC
Division of Varian

SK-700 AND SK-710 AIR-SYSTEM SOCKETS

The EIMAC SK-700 and SK-710 Air-System Sockets are designed to socket the EIMAC 4CX300A. Connections are made to each of the tube electrodes except the anode. An integral screen-grid by-pass capacitor is built into the socket.



SK-700

SK-700

The cathode contacts are insulated from ground.

SK-710

All six of the cathode contacts are connected directly to the metal body.

HEATER CONNECTIONS

In both socket types, one heater contact is connected directly to the metal body.



SK-700 WITH SK-606

SCREEN-GRID BY-PASS CAPACITOR

The capacitor is built into the socket and provides a low-impedance path to ground for screen-grid rf currents. It is tested at 1000 volts dc and rated at 400 volts dc. Capacitance is 1100 picofarads ±20%.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is made of silver-plated brass. The non-ferrous alloy contacts are heat treated after forming and then silver-plated. Three silver-plated brass toe clamps are supplied for mounting purposes.

The socket insulating material is chemically inert, non-flammable, and will not absorb water or water vapor. It is not affected by strong or weak acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds, which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of —150°C to +275°C and it is resistant to embrittlement and thermal shock.

A silvered-mica dielectric is used in the screen-grid by-pass capacitor.



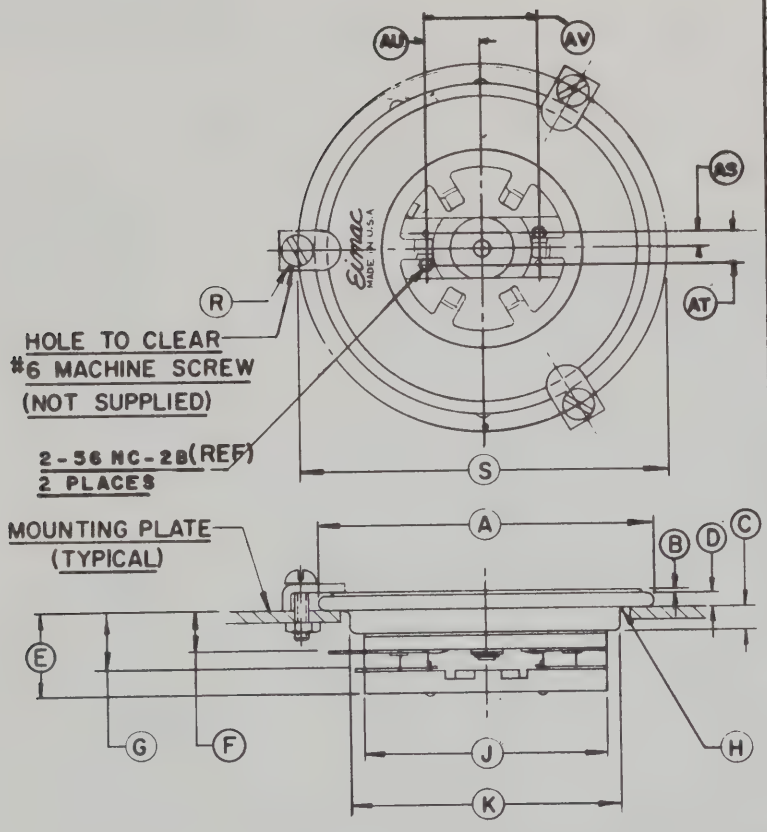
SOCKET, TUBE, AND CHIMNEY

AIR CHIMNEY

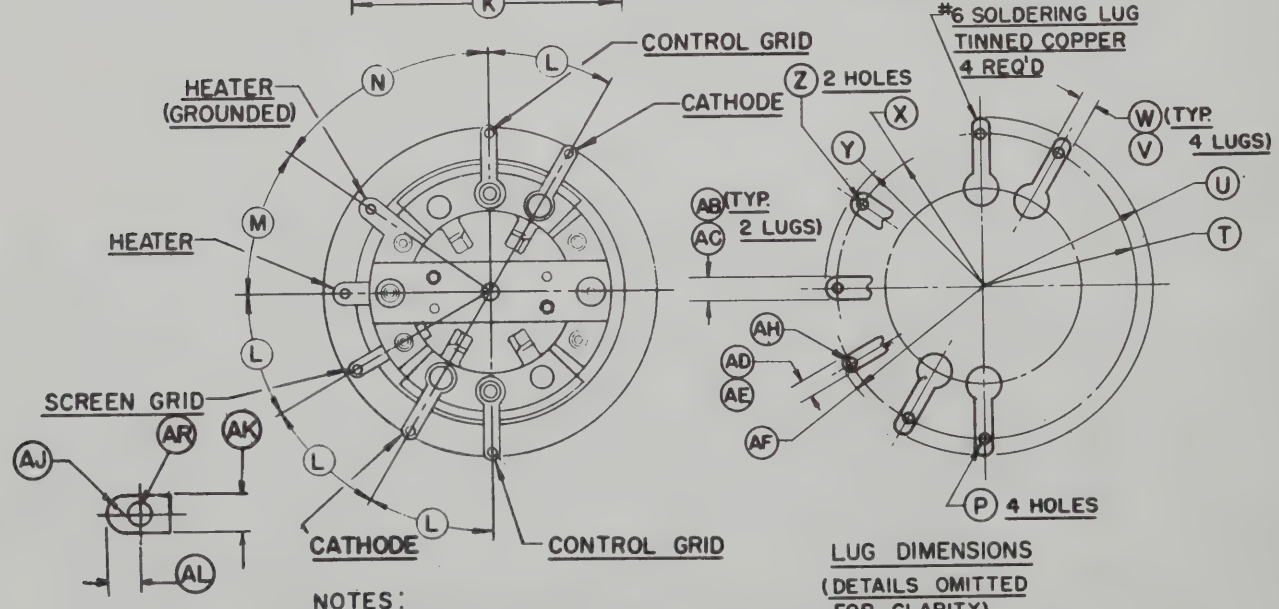
The SK-606 is intended to be used with the 4CX300A mounted vertically with the anode up. If horizontal mounting or vertical mounting with the anode down is required, means should be provided to retain the chimney. The air chimney is made of high-temperature ceramic and serves to direct the flow of air emerging from the socket into the anode cooling fins. It is recommended that the SK-606 chimney, or its equivalent, be used with each SK-700 or SK-710 socket.

(Revised 10-15-66) © 1958, 1966 Varian

Printed in U.S.A.

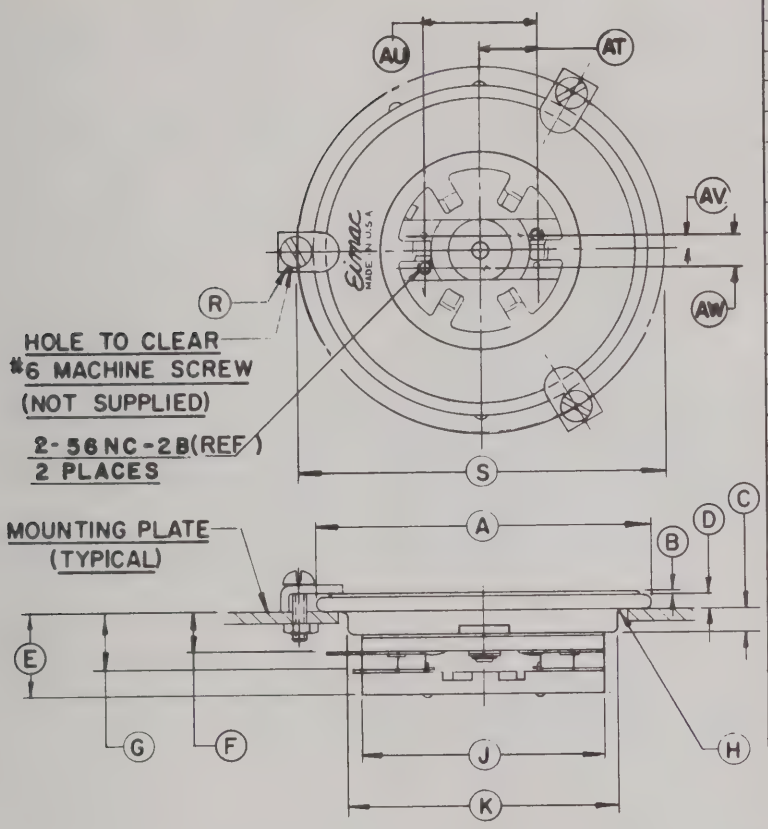


DIMENSION DATA			
DIM.	MIN.	MAX.	REF.
A	2.688 O.D.	2.750 O.D.	
B	.014	.046	
C	.175	.207	
D	.107	.147	
E	.650	.690	
F	.312	.352	
G	.453	.493	
H		.031 R.	
J			2 DIA.
K	2.184 O.D.	2.204 O.D.	
L	29°	31°	
M	34°	36°	
N	54°	56°	
P	.080 DIA.	.085 DIA.	
R	.142 DIA.		
S			3 DIA.
T			1 9/32 R
U			1 7/16 R
V	7/64	9/64	
W	.020 THK.	.030 THK.	
X			1 13/64 R
Y			1 5/16 R
Z	3/64 DIA.	5/64 DIA.	
AB	11/64	13/64	
AC	.005 THK.	.015 THK.	
AD	7/64	9/64	
AE	.015 THK.	.025 THK.	
AF	1 19/64 R.	1 21/64 R.	
AH	.065 DIA.	.075 DIA.	

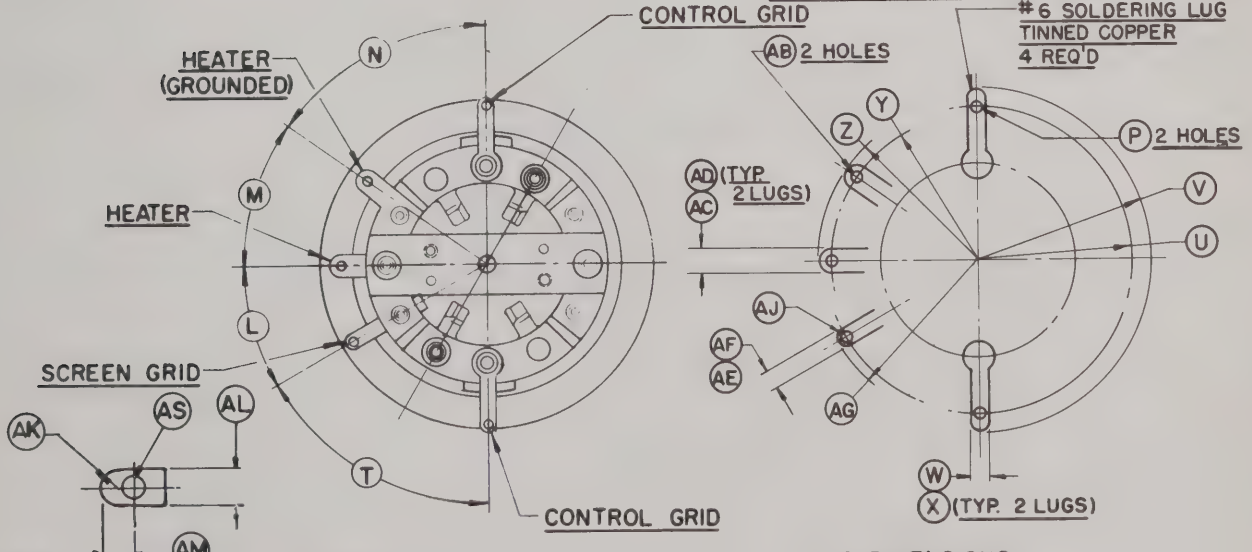


LUG DIMENSIONS
(DETAILS OMITTED FOR CLARITY)

NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.
3. CAPACITANCE 1100MMFD ± 20% VOLTAGE 1000 VDC TEST 400 WVDC.
4. REF. DIM. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES

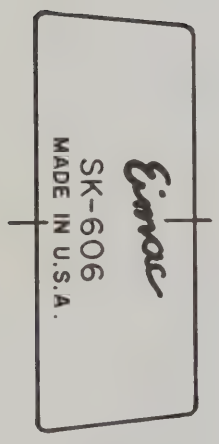


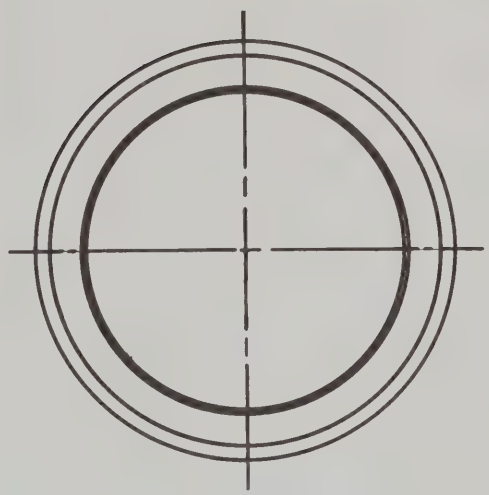
DIMENSION DATA			
DIM.	MIN.	MAX.	REF.
A	2.688 O.D.	2.750 O.D.	
B	.014	.046	
C	.175	.207	
D	.107	.147	
E	.650	.690	
F	.312	.352	
G	.453	.493	
H		.031 R.	
J			2 DIA.
K	2.184 O.D.	2.204 O.D.	
L	29°	31°	
M	34°	36°	
N	54°	56°	
P	.080 DIA.	.085 DIA.	
R	.142 DIA.		
S			3 DIA.
T	59°	61°	
U			1 9/32 R
V			1 7/16 R
W	7/64	9/64	
X	.020 THK.	.030 THK.	
Y			1 13/64 R
Z			1 5/16 R
AB	3/64 DIA.	5/64 DIA.	
AC	11/64	13/64	
AD	.005 THK.	.015 THK.	
AE	7/64	9/64	
AF	.015 THK.	.025 THK.	
AG	1 19/64 R.	1 21/64 R.	
AJ	.065 DIA.	.075 DIA.	



LUG DIMENSIONS
(DETAILS OMITTED
FOR CLARITY)

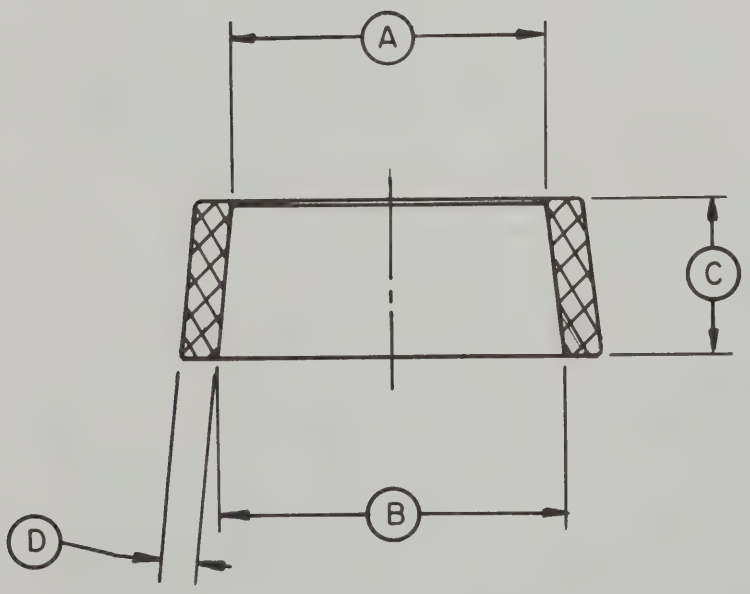
NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.
3. CAPACITANCE 1100 MMFD ± 20% - VOLTAGE 1000VDC - TEST 400WVDC
4. REF. DIM. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES





DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	1.635	1.700	
B	1.781	1.881	
C	.812	.875	
D	.156	.218	



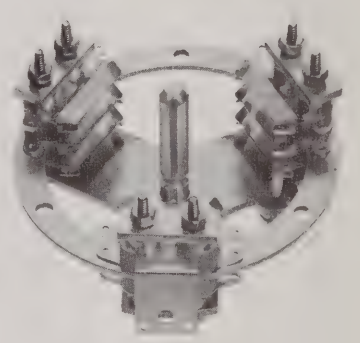
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-860
SK-870

AIR-SYSTEM SOCKET

The EIMAC SK-860 and SK-870 are air-system sockets recommended for use with the EIMAC 3CX1000A7 triode. A companion SK-816 Air Chimney is also available and is recommended for use with the socket.

When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-860 and SK-870 are humidity and salt-spray resistant.



BASE CONNECTIONS

The SK-860 and SK-870 sockets consist of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact) and a center guide to facilitate tube installation. The terminals are shown on the outline drawing.

No contacts are grounded on the SK-860, while the SK-870 has the grid contacts grounded to the equipment chassis when installed.

MATERIALS and FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are a one-piece nickle-plated die casting. All contacts are formed of a non-ferrous alloy, heat treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-860 and SK-870 are designed for under-chassis mounting and require a 5-1/16" hole through the chassis deck. The socket is held in place by the six 4-40 studs provided on the socket. The grid of the SK-870 is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-816 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-860 and SK-870.

NET WEIGHT . . . . . 12 ounces

(Revised 3-15-67) © 1963, 1967 by Varian

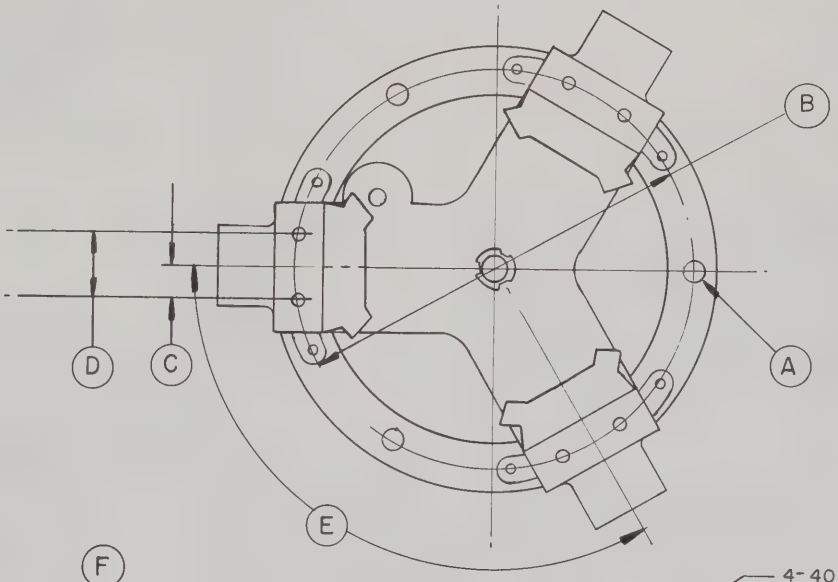
Printed in U.S.A.

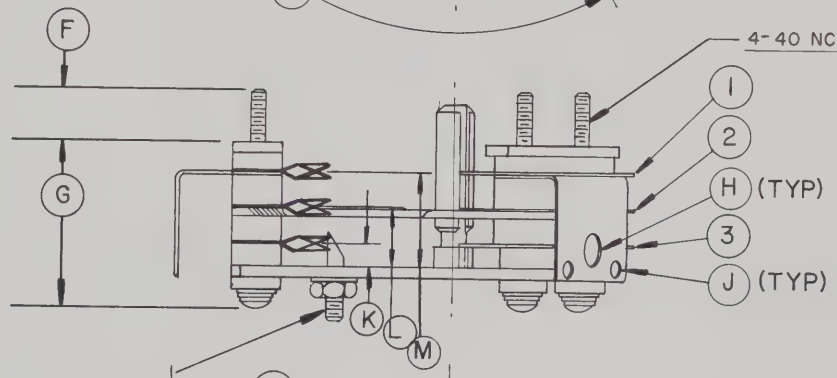
DIMENSIONS IN INCHES

DIMENSIONAL DATA

DIM.	MIN.	MAX.	REF.
A	.160	.180	
B	3.040	3.085	
C	.234	.266	
D	.484	.516	
E	119°	121°	
F			.270
G	1.275	1.295	
H			.170
J			.022
K	.160	.180	
L	.430	.460	
M	.690	.735	
N			1.957
P	29°	31°	
R			.042
S			.042

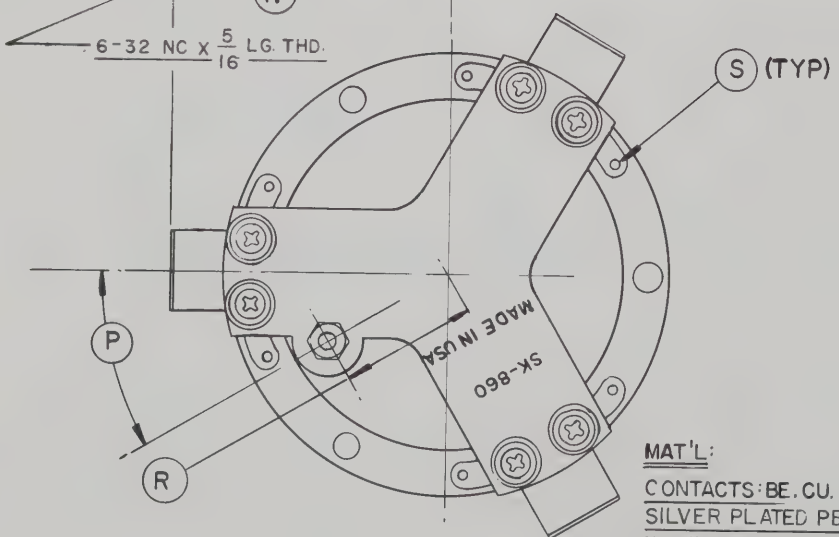
NOTE: REF. DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.





NOTE

1. GRID
2. CATHODE HEATER
3. HEATER



MAT'L:

CONTACTS: BE. CU. PER FEDERAL QQ-C-533
SILVER PLATED PER QQ-S-365
INSULATION: HIGH TEMP. CERAMIC
BASE: ZINC ASTM SPEC. (B-240) NI. PL.
PER QQ-N-290 CLASS 1, TYPE IX
SCREWS: BRASS, NI. PL. PER QQ-N-290
CLASS 1, TYPE VI

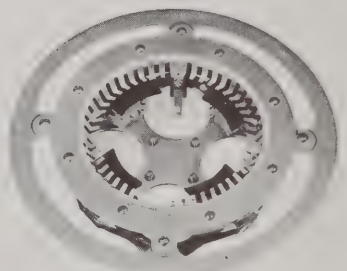
06980	SK-860
CODE IDENT	PART NO.

EIMAC
Division of Varian

SK-1400A
SK-1470A

AIR-SYSTEM SOCKETS

The EIMAC SK-1400A and SK-1470A Air-System Sockets are intended for use with the 4CX3000A and the 4CV8000A. The SK-1400A incorporates an integral screen by-pass capacitor and has no grounded contacts. The SK-1470A does not include a by-pass capacitor but does have the screen contacts grounded to the socket mounting plate.



BASE CONNECTIONS

A continuous screen grid contact finger assembly is provided for making contact with the solid screen ring flange on the 4CX3000A or 4CV8000A. Grid and filament connections to the tube are made by four rows of contact tab assemblies that provide for breech-block electrical and mechanical contact.

Each grid contact is terminated in two machine screws at the bottom of the socket base. Filament connections are to a terminal strap and to the socket base.

BY-PASS CAPACITOR

The SK-1400A is provided with an integral 1800 picofarad screen by-pass capacitor rated at 1000 volts dc. The screen contact fingers are attached to one side of this capacitor. The SK-1470A does not contain this capacitor; instead the screen contacts are grounded directly to the socket shell.

INSTALLATION

When mounted on a chassis or pressurized compartment, a 7¼" diameter hole is required for the socket. The socket is secured by eight #6 screws on a 7¾" bolt circle. These same screws are used to install the companion SK-1406 chimney used with the air-cooled 4CX3000A.

MATERIALS

The contact fingers and tabs are non-ferrous spring alloy, heat-treated and silver-plated. The socket body is made of silver-plated brass.

CHIMNEY

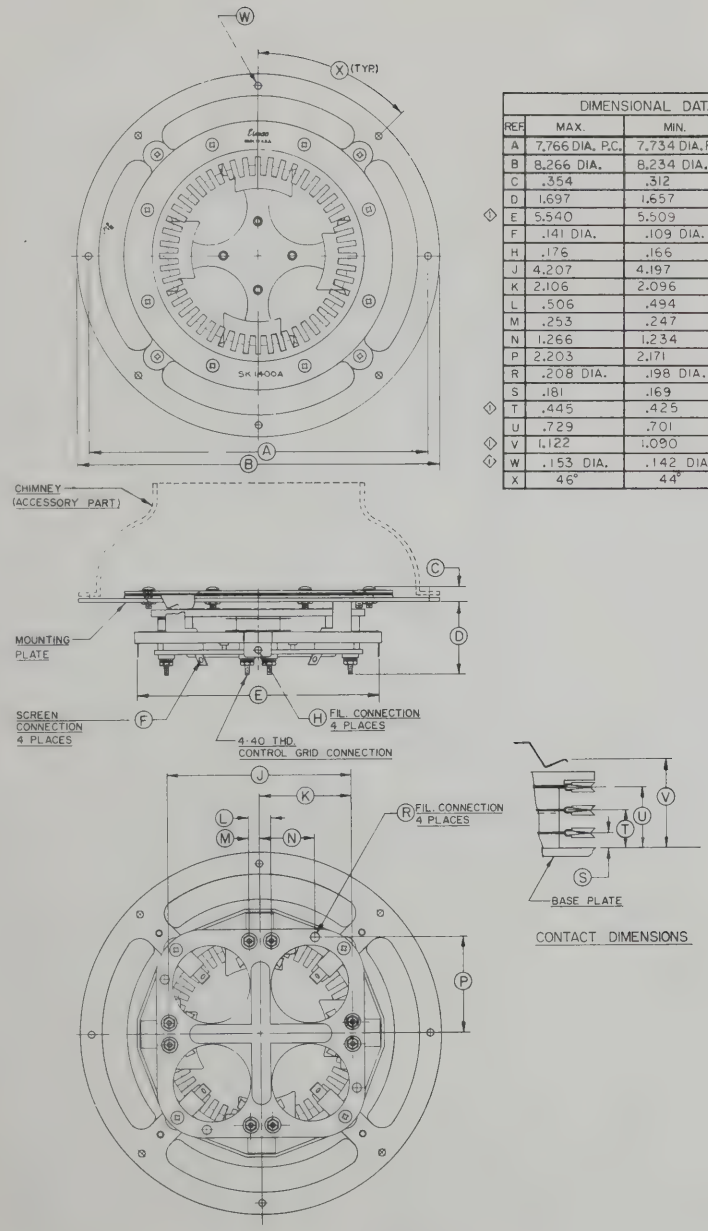
The SK-1406 chimney is available for use with the SK-1400A or SK-1470A and the air-cooled 4CX3000A. It effectively directs air that has passed through the socket into the anode cooling fins.

Note: Where a "floating" socket is desired — especially for the 4CV8000A—the SK-1490 is available. This is a SK-1470 without the mounting ring and is intended for use where the tube is fixed and the socket is to be removable.

Net Weight - - - - - - - - - - - - - - - - - - 30 ounces

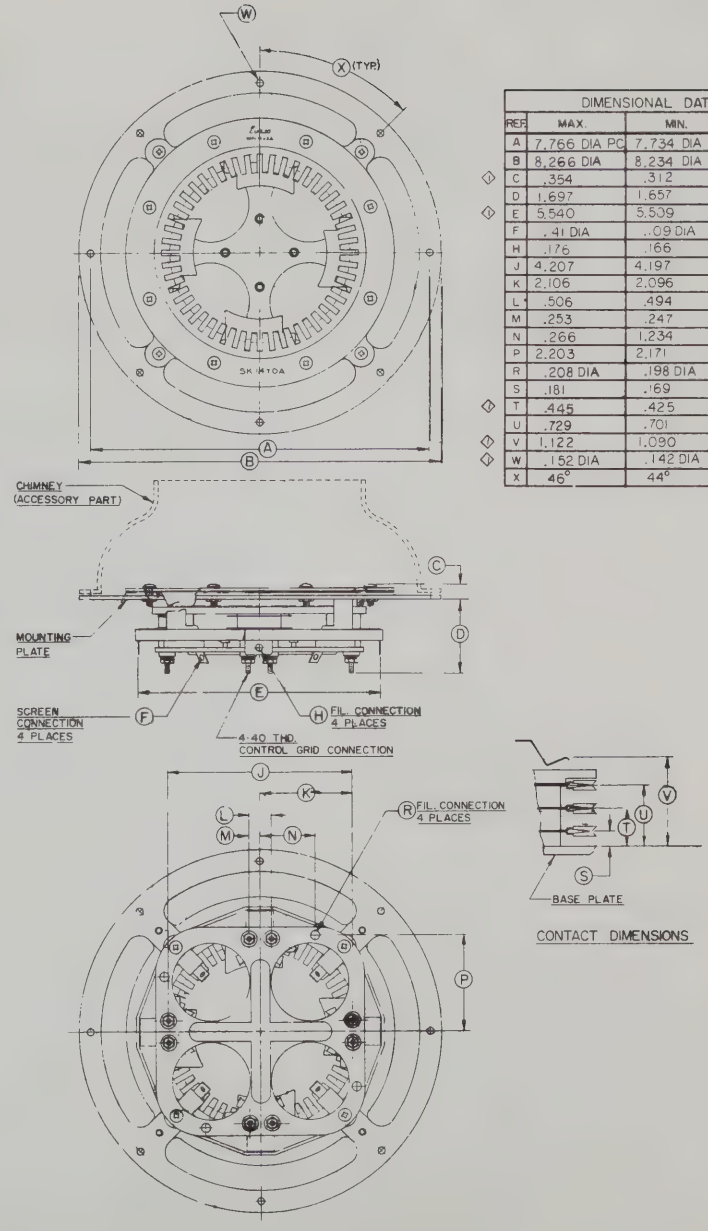
(Revised 10-15-66) © 1963, 1966 Varian

Printed in U.S.A.



DIMENSIONAL DATA				
REF.		MAX.	MIN.	NOM.
A		7.766 DIA. P.C.	7.734 DIA. P.C.	
B		8.266 DIA.	8.234 DIA.	
C		.354	.312	
D		1.697	1.657	
E	◇1	5.540	5.509	
F		.141 DIA.	.109 DIA.	
H		.176	.166	
J		4.207	4.197	
K		2.106	2.096	
L		.506	.494	
M		.253	.247	
N		1.266	1.234	
P		2.203	2.171	
R		.208 DIA.	.198 DIA.	
S		.181	.169	
T	◇1	.445	.425	
U		.729	.701	
V	◇1	1.122	1.090	
W	◇1	.153 DIA.	.142 DIA.	
X		46°	44°	

SK-1400A



DIMENSIONAL DATA				
REF.		MAX.	MIN.	NOM.
A		7.766 DIA PC	7.734 DIA PC	
B		8.266 DIA	8.234 DIA	
C	◇1	.354	.312	
D		1.697	1.657	
E	◇1	5.540	5.509	
F		.41 DIA	..09 DIA	
H		.176	.166	
J		4.207	4.197	
K		2.106	2.096	
L		.506	.494	
M		.253	.247	
N		.266	1.234	
P		2.203	2.171	
R		.208 DIA	.198 DIA	
S		.181	.169	
T	◇1	.445	.425	
U		.729	.701	
V	◇1	1.122	1.090	
W	◇1	.152 DIA	.142 DIA	
X		46°	44°	

SK-1470A



EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

TABLE OF CONTENTS

VOLUME I

GENERAL

	Effective Date
Tube Type Numbering System	2-1-67
Distributors	5-15-66
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet	1-1-67
Power Frequency Chart for Power Grid	

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	12-15-65
2-240A	10-21-59
2-450A	3-1-66
2-2000A	7-1-52
2X3000F	3-1-67
250R	12-15-65
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	11-1-66
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	6-1-66
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65
KY21A	7-1-66
RX21A	1-2-63

TRIODES

2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	3-15-67
3-1000Z/8164	3-15-67
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	3-1-67
3CW5000H3	4-1-66
3CW10,000H3	7-15-66
3CW20,000A1	1-1-63
3CW20,000A3	6-1-66
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	3-1-67
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-15-66
3CX2500A3/8161	3-1-67
3CX2500F3	3-1-67
3CX2500H3	3-15-66

TRIODES (Continued)

3CX5000H3	4-1-66
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	11-1-63
3CX10,000H3	3-15-66
3CX15,000A3	4-11-64
3CX15,000H3	4-1-66
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
25T	12-15-65
35T	12-30-57
*35TG	5-1-62
75TH	12-15-65
75TL	4-1-67
100TH	4-1-67
100TL	———
*152TH	11-25-52
*152TL	4-1-67
250TH	6-15-66
250TL	1-1-61
304TH	4-1-67
304TL	12-15-65
450TH	12-15-65
450TL	12-15-65
592/3-200A3	6-15-66
750TL	12-15-65
1000T	12-15-65
1500T	3-18-59
2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES

4-65A/8165	5-1-62
4-125A	12-15-65
4-250A/5D22	5-1-62
4-400A	8-30-66
4-1000A/8166	10-30-66
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	5-15-66
4CV100,000C/8351	3-15-65
4CW2000A	6-15-66
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61

TETRODES–PENTODES (Continued)

4CX300A/8167	8-30-66
4CX300Y	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX600A	5-7-63
4CX1000A/8168	6-15-66
4CX1000K/8352	8-20-66
4CX1500B	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	5-1-67
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	8-15-66
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	8-30-66
4X150G/8172	6-15-66
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5-500A	11-15-65
5CX1500A	4-15-67

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
Preformed Contact Finger Stock	8-15-66
HR Heat Dissipating Connectors	12-1-65
SK-300A	11-1-64
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	11-1-65
SK-410	11-15-62
SK-500	3-15-67
SK-506, SK-516	8-15-64
SK-510	8-15-66
SK-600A, SK-610A	11-1-65
SK-606, SK-626, SK-636B	8-15-66
SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A	4-15-67
SK-740	8-15-66
SK-760, SK-770	8-15-66
SK-800B, SK-806	4-9-64
SK-810B, SK-806	4-9-64
SK-860, SK-870	3-15-67
SK-890B, SK-806	4-9-64
SK-900, SK-906	8-15-66
SK-1300	8-15-66
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66

*Not recommended for New Equipment Design.

Effective Date 6-1-67

EIMAC
Division of Varian

EIMAC TUBE TYPE NUMBERING SYSTEM

Since 1945 all new tube types developed by EIMAC have been given a type number chosen according to a coded number system. This system is designed to convey descriptive information about the tube.

In general, the type numbers consist of: a numeral indicating the number of electrodes, one or more letters denoting special characteristics, a numeral representing the plate dissipation, and a final letter to distinguish the tube from others bearing similar preceding letters and numerals. Triode types carry an additional number to indicate their approximate amplification factor.

To illustrate the method of coding and the information the type number conveys, a 100-watt, ceramic, external-anode, forced-air cooled EIMAC triode, type number 3CX100A5, is broken down as follows:

3CX100A5

Number of Electrodes
2–Diode
3–Triode
4–Tetrode
5–Pentode

Plate Dissipation
(Watts)

Amplification Factor
1–0 to 10
2–11 to 20
3–21 to 30
4–31 to 50
5–51 to 100
6–101 to 200
7–201 to 500
8–501 to 1000

Description
C –Ceramic Envelope (No Glass)
L –External Anode, Liquid Convection Cooling
N –External Anode, Natural Convection Air Cooling
P –Primarily for Pulse Applications
*R–Internal Anode, Radiation Cooled
W–External Anode, Water Cooled
X–External Anode, Forced-Air Cooled
*In older types, the dash, as in the case of the 4-250A, carries the meaning of "R" given above.

Version
Distinguishes tubes which, although alike as to number of electrodes and plate dissipation, are not necessarily interchangeable physically or electrically.

(Effective 2-1-67) © 1950, 1967 Varian

EIMAC Tube-Type Numbering System for Power Klystrons

In general, EIMAC power klystrons are described by a coded numbering system similar to that used to identify negative-grid tubes.

The type numbers contain: a numeral indicating the number of cavities along the beam, one or more letters denoting the type of tube and special characteristics if any, a numeral designating the collector dissipation, and a pair of letters, the first describing the frequency band in which the tube operates and the second describing the sub-band in which it operates.

As an example, the type number describing an EIMAC four-cavity klystron with modulating anode and 50,000-watt collector, designed for use in the "L" band is broken down as follows:

4KM50,000LR

Number of Cavities

Collector Dissipation
In klystron catalog numbers assigned prior to May 1, 1961 this was expressed in watts. In those assigned since that date it is expressed in kilowatts.

Sub-Band
Describes useful frequency sub-band. Since no standard sub-band assignment system exists EIMAC has evolved its own.

Description
K —Klystron
M—Utilizes Eimac Modulating Anode
P —Primarily for Pulse Applications

Frequency Band
(Megacycles)
P—225 to 390
L—390 to 1550
S—1550 to 3900
C—3900 to 6200
X—6200 to 10,900
K—10,900 to 36,000
Q—36,000 to 46,000
V—46,000 to 56,000

EIMAC
Division of Varian
PALO ALTO
CALIFORNIA

2X3000F

HIGH-VACUUM RECTIFIER



The EIMAC 2X3000F is a high-vacuum, forced-air cooled, external-anode diode intended for use in high-power rectifier units whenever high peak-inverse voltages, extreme ambient temperatures, high operating frequency, or the production of high-frequency transients would prevent the use of mercury-vapor or gas-filled rectifier tubes.

CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 volts
Current	51 amperes

MECHANICAL

Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Anode Core	175° C
Net Weight	5.7 pounds
Shipping Weight (Approximate)	17 pounds

MAXIMUM RATINGS

PEAK INVERSE PLATE VOLTAGE	25,000 VOLTS
PLATE DISSIPATION	3,000 WATTS
DC PLATE CURRENT	3 AMPERES
PEAK PLATE CURRENT	20 AMPERES

TYPICAL POWER-SUPPLY CAPABILITIES*

Circuit	Maximum AC Input Voltage (volts rms)	Approx. DC Output Voltage (volts)	Maximum DC Output Current (amps)
Single-Phase, Full-Wave (2 tubes)	17,700 total	8,000	6.0
Single-Phase, Bridge (4 tubes)	17,700 total	16,000	6.0
Three-Phase, Full-Wave (6 tubes)	10,200 per leg	24,000	9.0

*Choke-input filter with L equal to or greater than twice "critical"; zero circuit loss assumed.

COOLING

Sufficient forced air cooling must be provided to maintain seal and core temperature at 175°C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

The table below lists minimum air-flow requirements to maintain tube temperatures below 175°C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 40°C and sea level. A separate supply of approximately six cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

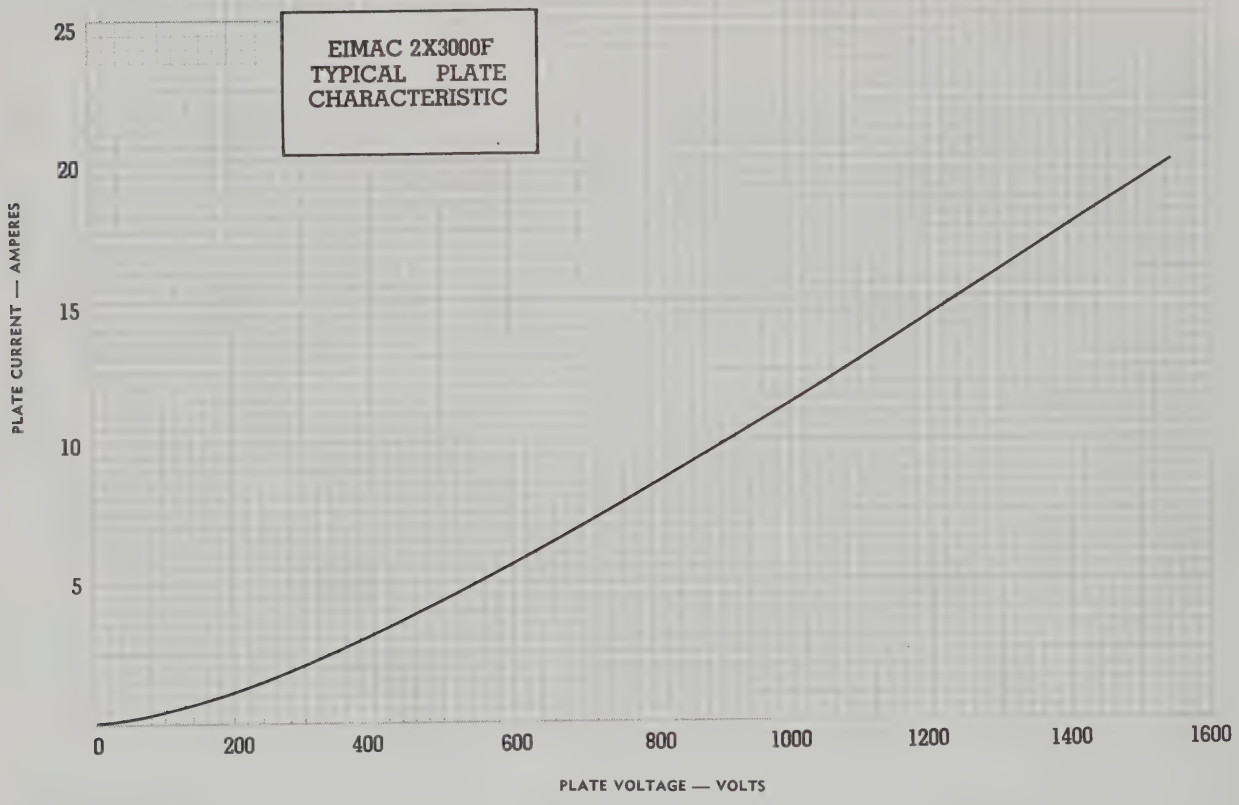
MINIMUM COOLING AIR-FLOW REQUIREMENTS				
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	Air-Flow (cfm)	Pressure Drop (inches of water)	Air-Flow (cfm)	Pressure Drop (inches of water)
1000	15	0.1	25	0.2
2000	45	0.4	75	1.2
3000	95	1.4	155	4.5

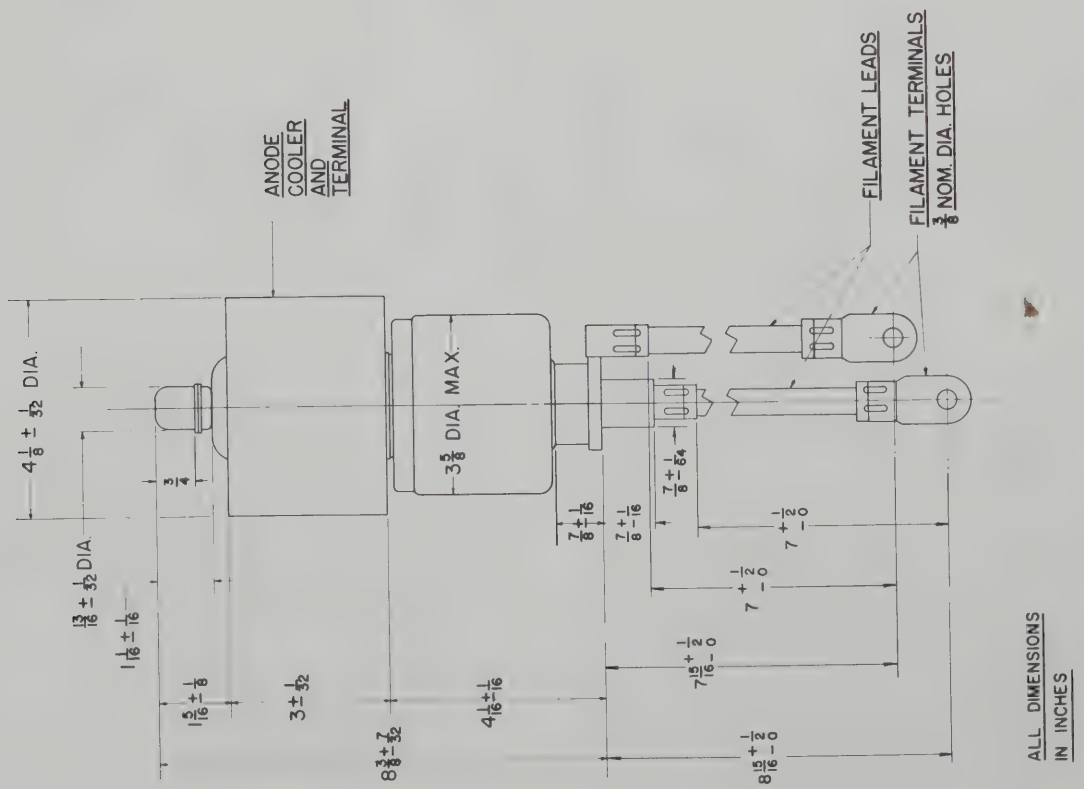
Note: An extra 375 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for filament dissipation.

For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

(Revised 3-1-67) © 1967 Varian

Printed in U.S.A.





Printed in U.S.A.

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8164
3-1000Z

HIGH-MU POWER TRIODE



The EIMAC 8164/3-1000Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8164/3-1000Z in a cathode driven circuit.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	21.5		22.7	amps
Amplification Factor (Average)		200		
Interelectrode Capacitance (Grounded Cathode)				
Input	15.0		19.0	pf
Output			0.3	pf
Grid-Plate	6.0		9.0	pf
Interelectrode Capacitance (Grounded-Grid)				
Input	15.0		19.0	pf
Output	6.0		9.0	pf
Plate-Cathode			0.3	pf
Frequency for Maximum Ratings			110	MHz

MECHANICAL

Base	5 Pin Special
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-8
Recommended Socket	EIMAC SK-510
Recommended Chimney	EIMAC SK-516
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-all Dimensions:	
Height	7.88 inches
Diameter	5.25 inches
Net Weight	1.2 pounds

(Revised 3-15-67) © 1962, 1964, 1967 by Varian

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER

Class C, Grid Driven

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	700 MA
GRID DISSIPATION	50 WATTS
PLATE DISSIPATION	1000 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000	4500	6000 volts
DC Grid Voltage	—30*	—75	—100 volts
DC Plate Current	700	700	700 mA
DC Grid Current	230	240	250 mA
Peak RF Grid Voltage	107	200	230 volts
Grid Driving Power	27	48	57 watts
Power Output	1300	2250	3200 watts

*Operating bias may be wholly derived from grid current flowing through 130 ohm, 25 watt resistor.

PLATE MODULATED RF AMPLIFIER

Class C

MAXIMUM RATINGS

DC PLATE VOLTAGE	4500 VOLTS
DC PLATE CURRENT	550 MA
GRID DISSIPATION	50 WATTS
PLATE DISSIPATION	670 WATTS

*Drive modulation is required with a high-mu triode

TYPICAL OPERATION*

DC Plate Voltage	4500 volts
DC Grid Voltage	—100 volts
DC Plate Current	500 mA
DC Grid Current	170 mA
Drive Power	35 watts
Output Power (carrier)	1765 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Clas B, Zero Bias, Cathode Driven

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	800 MA
GRID DISSIPATION	50 WATTS
PLATE DISSIPATION	1000 WATTS

*Measured values in operating equipment.

TYPICAL OPERATION

DC Plate Voltage	2500	3000 volts
Zero-Signal DC Plate Current	162	240 mA
Max. Signal DC Plate Current	800	670 mA
Max. Signal DC Grid Current	260	220 volts
Max. Signal Drive Power	100	90 watts
Plate Load Impedance	1760	2650 ohms
Nominal Cathode Impedance	65	67 ohms
Plate Output Power	1050	1080 watts
Intermodulation Distortion Products:* 3rd Order	—32	—29 db
5th Order	—39	—37 db

AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Class B

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	800 MA
PLATE DISSIPATION	1000 WATTS
GRID DISSIPATION	50 WATTS

*Approximate Value. Adjust to provide stated zero-signal plate current.

TYPICAL OPERATION
(Sinusoidal Wave, Two Tubes, Grid Driven)

DC Plate Voltage	3000	5000 volts
DC Grid Voltage	0	—13*volts
Zero-Signal DC Plate Current	350	200 mA
Max. Signal DC Plate Current	1450	1000 mA
Max. Signal DC Grid Current	485	310 mA
Driving Power	48	28 watts
Peak AF Driving Voltage	100	90 volts
Load Resistance Plate to Plate	3940	10,200 ohms
Max. Sig. Plate Output Power	2540	3560 watts

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MOUNTING—The 3-1000Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the EIMAC HR-8 Heat Dissipating Connector on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock. The EIMAC SK-510 socket or equivalent must be employed to prevent excess lateral pressure on base pins and seal of the tube.

COOLING—Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-510 Air-System Socket and SK-516 Chimney, a minimum air flow rate of 25 cubic feet per minute at a static pressure of approximately 0.43 inch of water, as measured at the socket at sea level, is required to provide adequate cooling at an inlet air temperature of 50°C. Above 30 megahertz the required air flow is increased to 35 cubic feet per minute at a static pressure of approximately 0.8 inch of water, as measured at the SK-510 socket. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-510 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate seal. In all cases, air flow rates in excess of the minimum requirements, will prolong tube life.

FILAMENT OPERATION—The rated filament voltage for the 3-1000Z is 7.5 volts. Filament voltage, as measured at the socket, must be maintained within the range of 7.13 to 7.87 volts to obtain maximum tube life. Operation at reduced voltage decreases emission capability, but increases life expectancy.

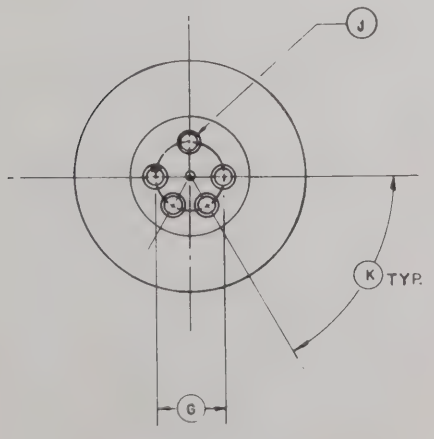
INTERMODULATION DISTORTION—Typical Operating Conditions and Intermodulation Distortion Product values are derived from measurements made at 2 MHz and are referred to one tone of a two-tone test signal. As the driving signal is reduced below full peak envelope power, distortion products remain at, or better than, the indicated value.

CLASS C OPERATION—Although designed for Class B service, the 3-1000Z may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristics can be used to advantage in Class C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

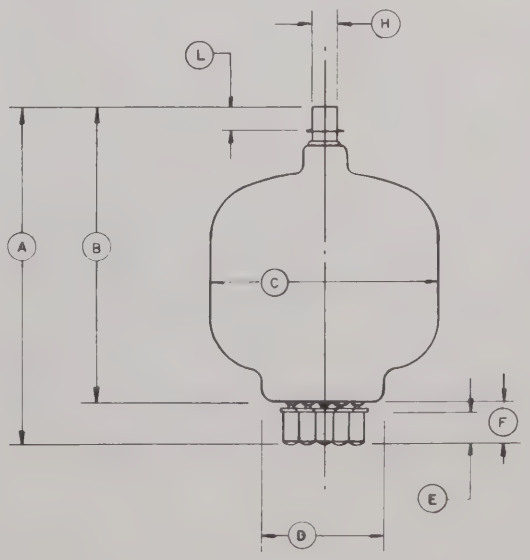
ZERO-BIAS OPERATION—Operating at zero-bias is not recommended with plate voltages over 3500 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias operation as mentioned above under "Class-C Operation" is not available at plate voltages above 3500 volts. Straight Class-C or Class-B operation is, of course, permissible up to 6000 volts where other ratings are not exceeded.

INPUT CIRCUIT — When the 3-1000Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

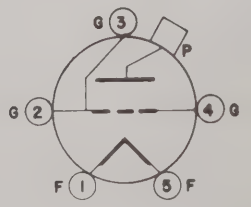
SPECIAL APPLICATIONS—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

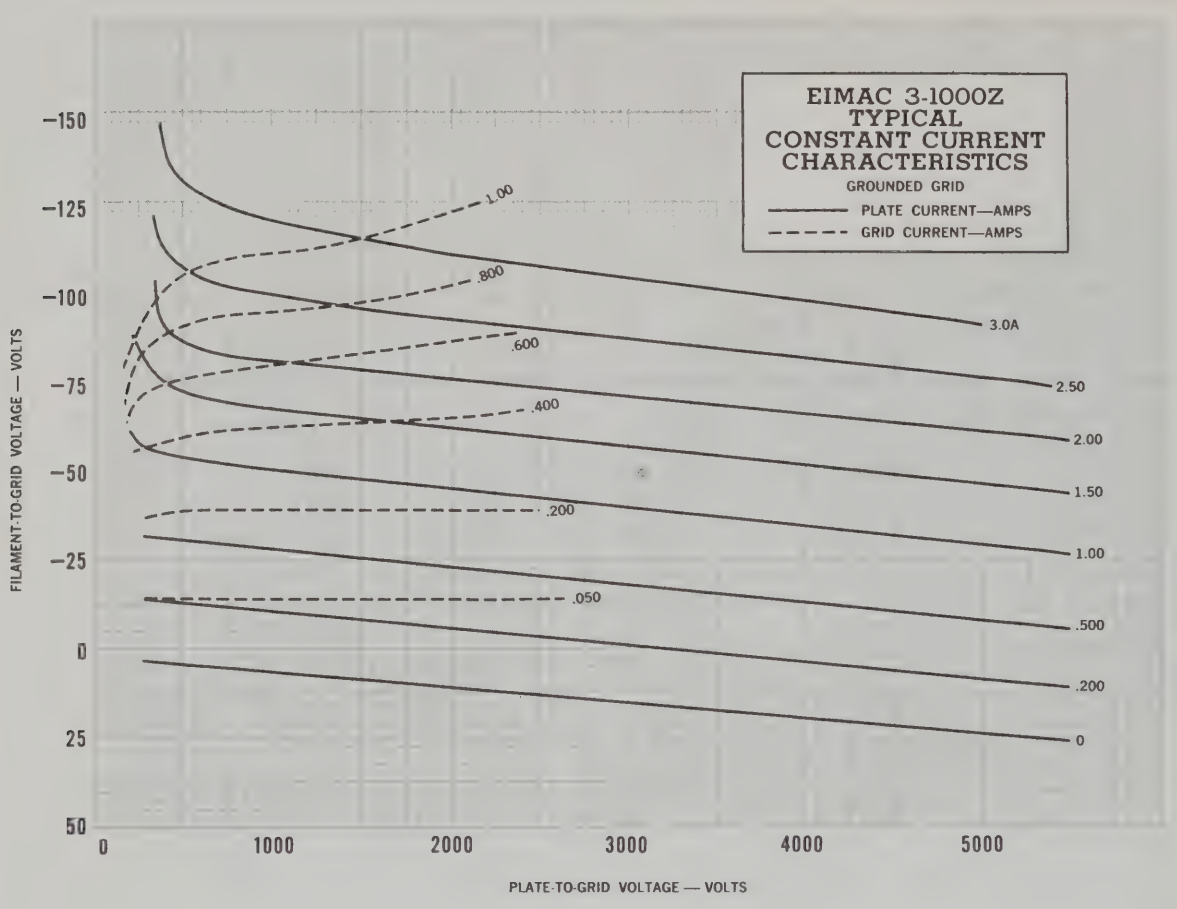


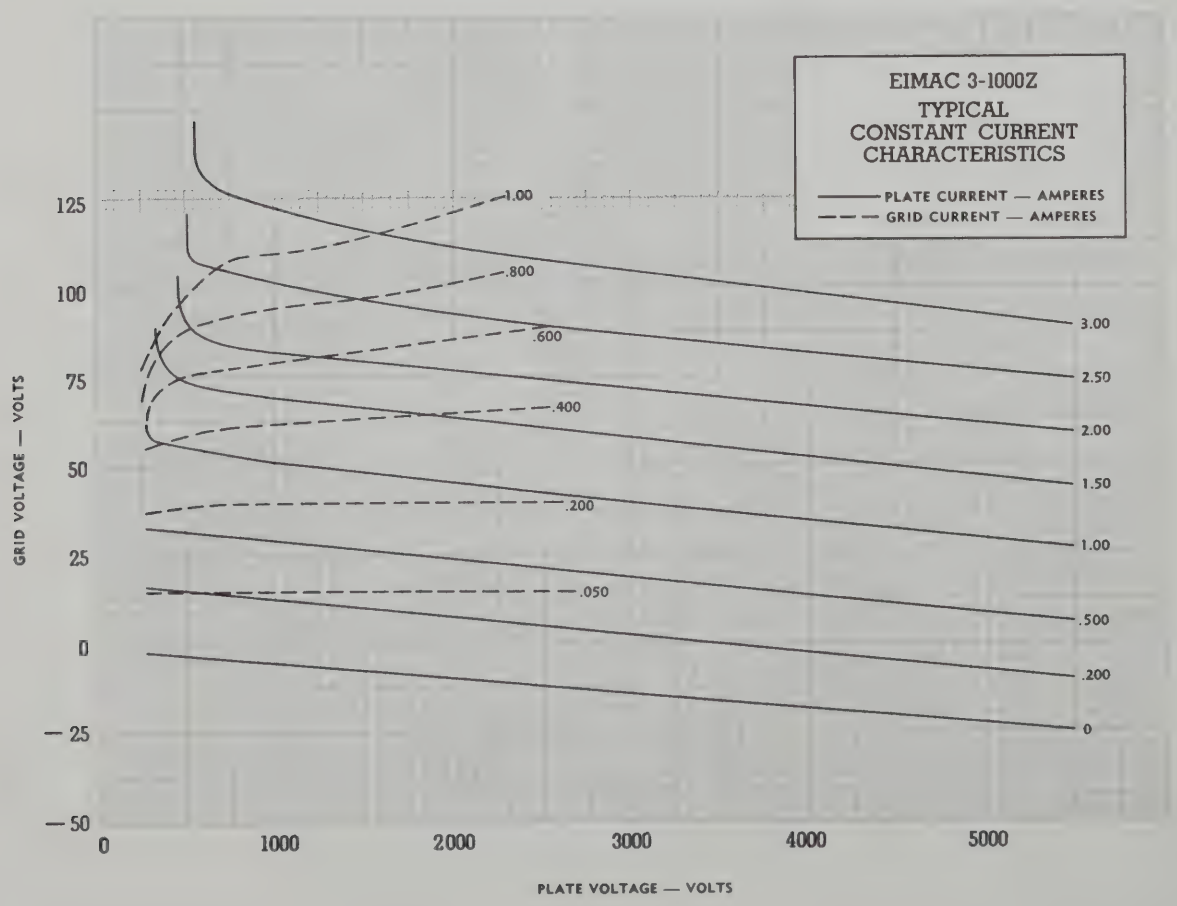
BOTTOM VIEW



REF	MIN.	NOM.	MAX.
A	7 1/2		7 7/8
B	6 11/16		7 1/16
C			5 1/4
D	2 3/4		2 7/8
E	17/32		21/32
F	25/32		29/32
G		1.500	
H	.559		.573
J	.371		.377
K		60°	
L	540		.560




EIMAC 3-1000Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT—AMPS
GRID CURRENT—AMPS
FILAMENT-TO-GRID VOLTAGE — VOLTS
PLATE-TO-GRID VOLTAGE — VOLTS
−150
−125
−100
−75
−50
−25
0
25
50
0
1000
2000
3000
4000
5000
1.00
.800
.600
.400
.200
.050
3.0A
2.50
2.00
1.50
1.00
.500
.200
0


EIMAC 3-1000Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
125
100
75
50
25
0
— 25
— 50
0
1000
2000
3000
4000
5000
1.00
.800
.600
.400
.200
.050
3.00
2.50
2.00
1.50
1.00
.500
.200
0

EIMAC

A Division of Varian Associates

8161
3CX2500A3

MEDIUM MU TRIODE

The EIMAC 3CX2500A3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500A3 is an exact replacement for the EIMAC 3X2500A3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube has a rugged, low-inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals. The 3CX2500A3 may be installed or removed without the aid of tools.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	pF
Grid-Filament	29.2		40.2	pF
Plate-Filament	0.6		1.2	pF
Tranconductance (Ib=830 ma., Eb=3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			75	MHz

MECHANICAL

Base	See drawing
Mounting	Vertical, base down or up
Cooling	Forced Air
Maximum Anode Core and Seal Temperatures	250°C
Maximum Over-all Dimensions:	
Length	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds
Shipping Weight (Average)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier, (Frequencies below 75 MHz.)

Class-C FM or Telegraphy (Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	2500 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION (Frequencies below 75 MHz per tube)

DC Plate Voltage	4000	5000	6000	volts
DC Plate Current	2.5	2.5	2.08	amps
DC Grid Voltage	—300	—450	—500	volts
DC Grid Current*	245	265	180	ma
Peak RF Grid Input Voltage*	580	750	765	volts
Driving Power*	142	197	136	watts
Grid Dissipation*	68	78	46	watts
Plate Power Input	10,000	12,500	12,500	watts
Plate Dissipation	2500	2500	2500	watts
Plate Power Output	7500	10,000	10,000	watts

*Approximate values.

(Revised 3-1-67) © 1967 Varian

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier, (Frequencies below 75 MHz.)

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.0	AMPS
PLATE DISSIPATION	1670	VOLTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Frequencies below 75 MHz per tube)

DC Plate Voltage	4000	4500	5000	volts
DC Plate Current	1.67	1.47	1.25	amps
DC Grid Voltage	—450	—500	—550	volts
DC Grid Current*	180	140	150	ma
Peak RF Grid Input Voltage*	685	715	760	volts
Driving Power*	125	100	115	watts
Grid Dissipation*	43	30	32	watts
Plate Power Input	6670	6615	6250	watts
Plate Dissipation	1670	1315	950	watts
Plate Power Output	5000	5300	5300	watts

*Approximate values.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	2500	WATTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage[1]	—150	—190	—240	volts
Zero-Signal DC Plate Current	0.6	0.5	0.4	amps
Max-Signal DC Plate Current	4.0	3.2	3.0	amps
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390	volts
Max-Signal Peak Driving Power*	340	230	225	watts
Max-Signal Nominal Driving Power*	170	115	113	watts
Max-Signal Plate Output Power	11,000	11,000	13,000	watts

*Approximate values.

[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDNG THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Cooling—Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 MHz, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Anode-to-Base Air Flow[1]				
	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air Flow				
	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1] When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage — The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

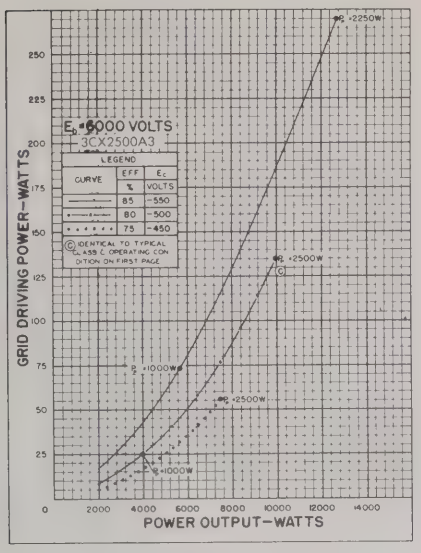
Bias Voltage — There is little advantage in using bias voltages in excess of those given under "TYPICAL OPERATION" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

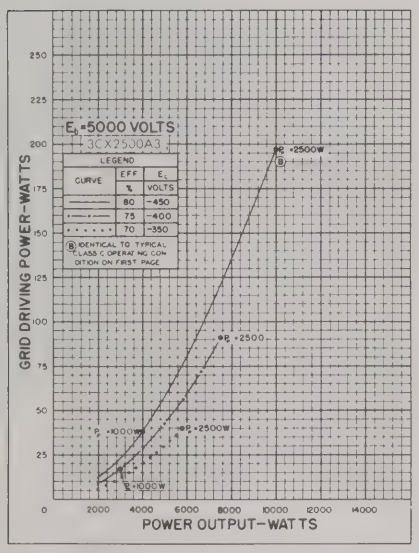
Plate Voltage — The plate-supply voltage for the 3CX2500A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "TYPICAL OPERATION" for the power output desired.

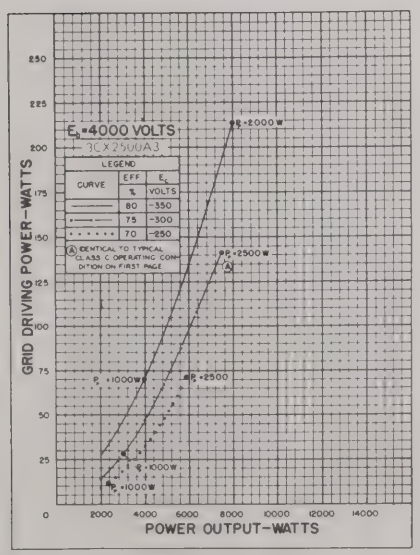
Grid Dissipation — The power dissipated by the grid of the 3CX2500A3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

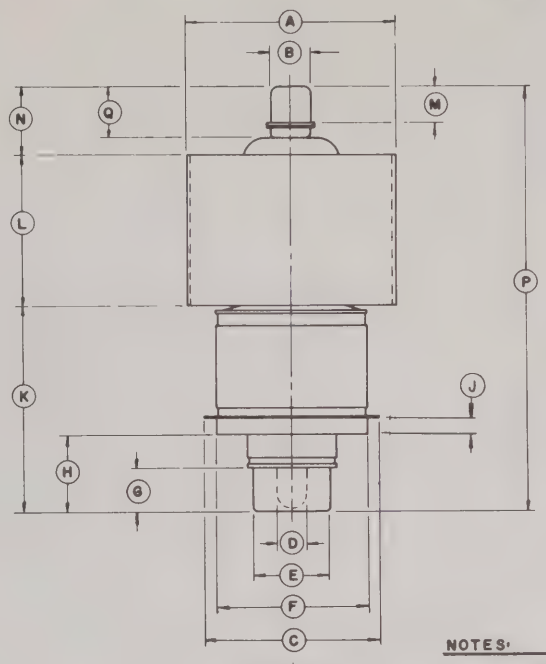
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

InVHF operation, particularly above 75 MHz the dc grid current must not exceed 200 ma under any conditions of plate loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.

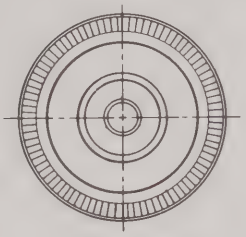








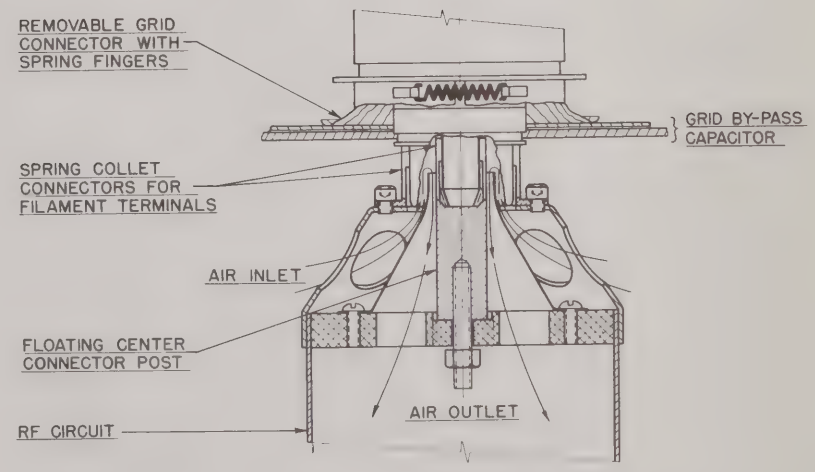
DIMENSIONAL DATA			
REF.	MIN	MAX	NOM
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	.615	.635	
E	1.490	1.510	
F	2.990	3.010	
G	13/16	15/16	
H	1 3/8	1 5/8	
J	3/8	7/16	
K	3 7/8	4 1/4	
L	2 15/16	3 1/16	
M	11/16	13/16	
N	1 3/16	1 11/16	
P	8	9	
Q	1	1 1/8	



BOTTOM VIEW

NOTES:

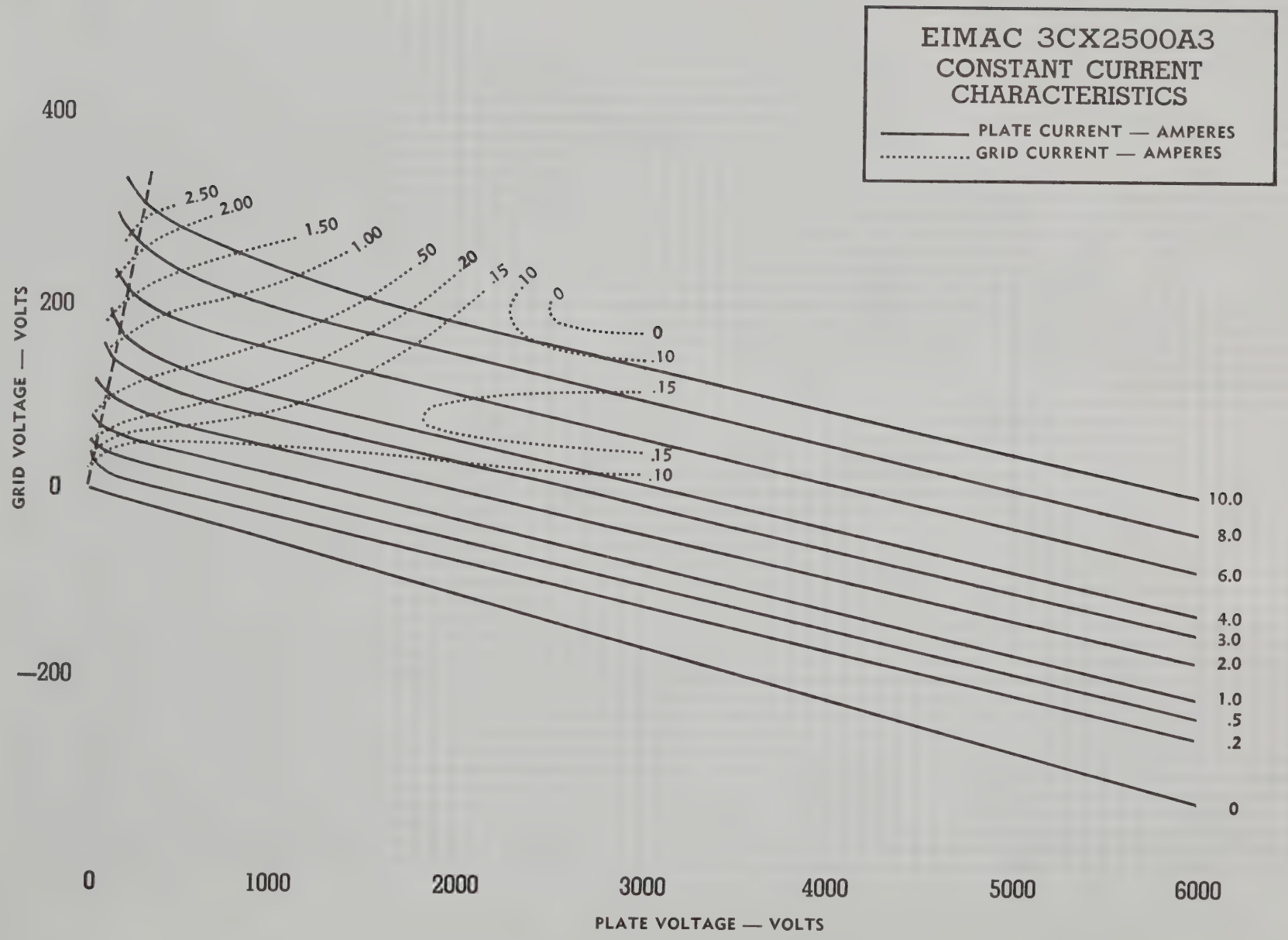
1. .040 MAXIUM RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAXIUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.
3. DIMENSIONS IN INCHES.



TYPICAL TUBE CONNECTORS AND STEM COOLING

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3CX2500A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

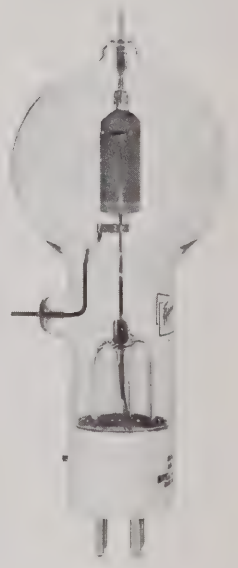
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

75TL

LOW-MU TRIODE
•
MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 75TL is a low-mu power triode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate dissipation rating of 75 watts and a maximum plate voltage rating of 3000 volts at frequencies up to 40 MHz. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 MHz.

The 75TL in Class-C RF service will deliver up to 225 watts plate power output with 8 watts driving power. Two 75TL's in Class-B modulator service will deliver up to 350 watts maximum-signal plate power output with 5 watts driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten		
Voltage	5.0	volts
Current	6.25	amperes
Amplification Factor (Average)	12	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	2.4	pF
Grid-Filament	2.6	pF
Plate-Filament	0.4	pF
Transconductance (I_b = 225 ma., E_b = 2500v.)	3350	μmhos
Highest Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	Medium 4-pin bayonet
Basing	See outline drawing
Socket	Johnson type No. 122-224, National type No. XC-4 or CIR-4, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat Dissipating Connectors:	
Plate	EIMAC HR-3
Grid	EIMAC HR-2
Maximum Overall Dimensions:	
Length	7.25 inches
Diameter	2.81 inches
Net Weight	3 ounces
Shipping Weight (Average)	1.5 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy (Key-down conditions, 1 tube)

Maximum Ratings (Frequencies up to 40 MHz)

DC Plate Voltage	3000	volts
DC Plate Current	225	ma.
Plate Dissipation	75	watts
Grid Dissipation	13	watts

Typical Operation (Frequencies up to 40 MHz)

DC Plate Voltage	1000	1500	2000	volts
DC Grid Voltage	−150	−250	−300	volts
DC Plate Current	215	167	150	ma.
DC Grid Current	28	22	21	ma.
Peak RF Grid Input Voltage (approx.)	320	355	425	volts
Driving Power (approx.)	8	6	8	watts
Plate Power Input	215	250	300	watts
Plate Dissipation	75	75	75	watts
Plate Power Output	140	175	225	watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

Maximum Ratings (Frequencies up to 40 MHz)

DC Plate Voltage	2400	volts
DC Plate Current	180	ma.
Plate Dissipation	50	watts
Grid Dissipation	13	watts

Typical Operation (Frequencies up to 40 MHz)

DC Plate Voltage	1000	1500	2000	volts
Total Bias Voltage	−250	−370	−500	volts
Fixed Bias Voltage	−130	−260	−380	volts
Grid Resistor	7500	6000	6000	ohms
DC Plate Current	135	130	130	ma.
DC Grid Current (approx.)	16	18	20	ma.
Peak RF Grid Input Voltage (approx.)	410	545	695	volts
Driving Power (approx.)	6	10	14	watts
Grid Dissipation	2	3	4	watts
Plate Power Input	135	195	260	watts
Plate Dissipation	50	50	50	watts
Plate Power Output	85	145	210	watts

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING MAXIMUM RATINGS, WRITE EIMAC DIVISION OF VARIAN FOR INFORMATION AND RECOMMENDATIONS.

(Revised 4-1-67) © 1952, 1967 Varian

Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class–AB_1

Maximum Ratings (Per tube)

DC Plate Voltage	3000	volts
Max-Signal DC Plate Current	225	ma.
Plate Dissipation	75	watts

Typical Operation (Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1500	2000	volts
DC Grid Voltage	−130	−190	volts
Peak AF Grid Input Voltage (per tube)	130	190	volts
Zero-Signal DC Plate Current	67	50	ma.
Max-Signal DC Plate Current	143	130	ma.
Driving Power	0	0	watt
Effective Load, Plate-to-Plate	10,200	21,200	ohms
Max-Signal Plate Power Output	64	110	watts
Max-Signal Plate Dissipation (per tube)	75	75	watts
Total Harmonic Distortion	3.0	3.5	per cent

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class–AB_2

Maximum Ratings (Per tube)

DC Plate Voltage	3000	volts
Max-Signal DC Plate Current	225	ma.
Plate Dissipation	75	watts
Grid Dissipation	13	watts

[1] Adjust to give stated zero-signal plate current. The effective grid-circuit resistance for each tube must not exceed 250,000 ohms in class-AB_1 operation

Typical Operation (Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1000	1500	2000	volts
DC Grid Voltage[1]	−70	−130	−190	volts
Peak AF Grid Input Voltage (per tube)	215	250	300	volts
Zero-Signal DC Plate Current	100	67	50	ma.
Max-Signal DC Plate Current	350	285	250	ma.
Max-Signal Avg. Driving Power (approx.)	7	6	5	watts
Max-Signal Peak Driving Power	26	23	19	watts
Effective Load, Plate-to-Plate	5300	11,000	18,000	ohms
Max-Signal Plate Power Output	200	280	350	watts
Max-Signal Plate Dissipation (per tube)	75	75	75	watts
Total Harmonic Distortion	2.0	4.5	6.0	per cent

APPLICATION

MECHANICAL

Mounting—The 75TL must be mounted vertically, base down or up. The plate and grid leads should be flexible. The tube must be protected from vibration and shock.

Cooling—Heat Dissipating Connectors (EIMAC HR-3 and HR-2) should be used at the plate and grid terminals of the 75TL. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling for the plate and grid seals.

Cooling requirements will be met if the temperature of the plate and grid seals is not allowed to exceed 225°C. One method of measuring these temperatures is provided by the use of "Tempilaq," a temperature-sensitive lacquer available from the Tempil Corporation, New York 11, N.Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range of 4.75 to 5.25 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 75TL, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate-supply voltage for the 75TL should not exceed 3000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

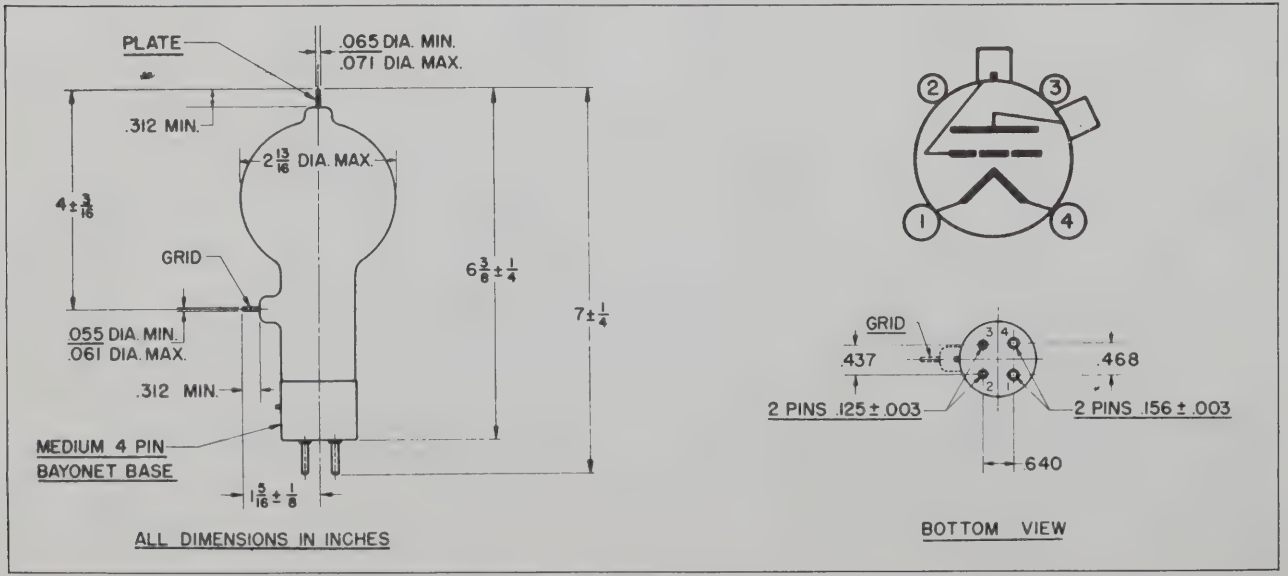
Grid Dissipation—The power dissipated by the grid of the 75TL must not exceed 13 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = DC grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

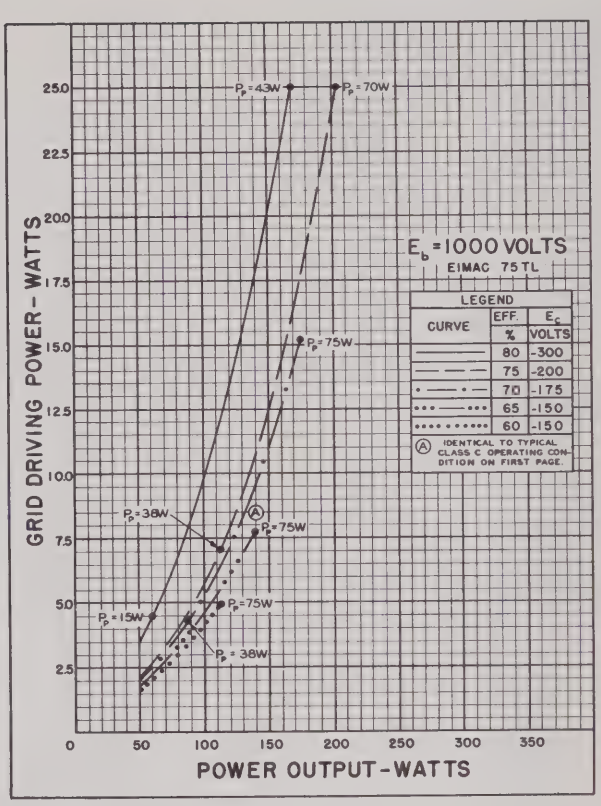
Plate Dissipation—The plate of the 75TL operates at a visibly red temperature at its maximum rated dissipation of 75 watts. Plate dissipation in excess of the maximum rating is permissible only for short periods of time, such as during tuning procedures.

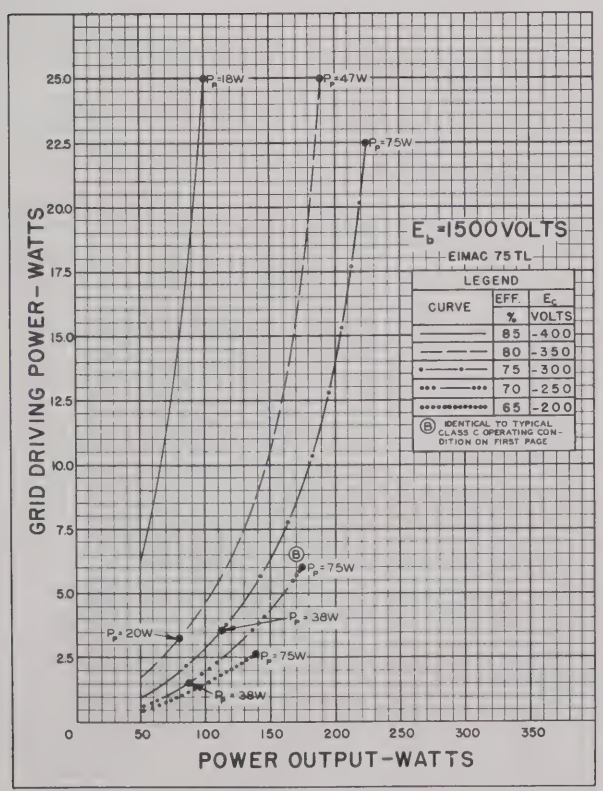


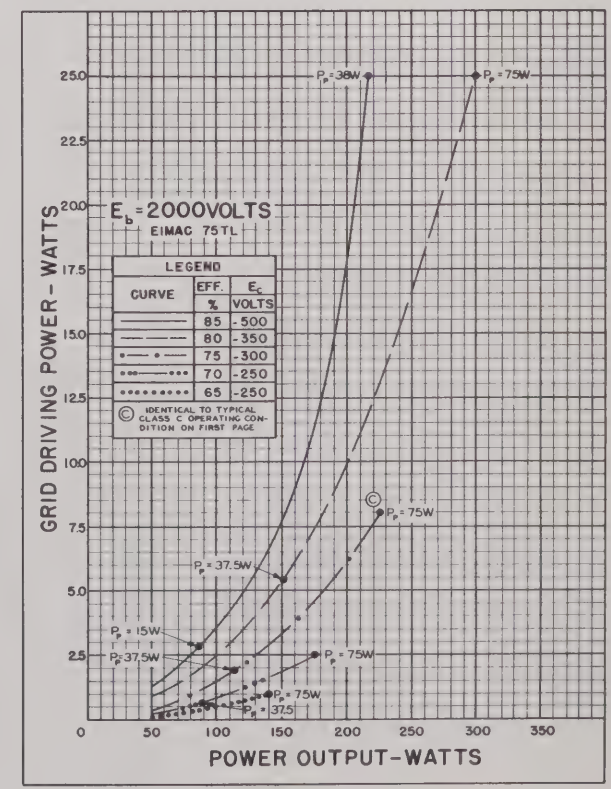
DRIVING POWER vs. POWER OUTPUT

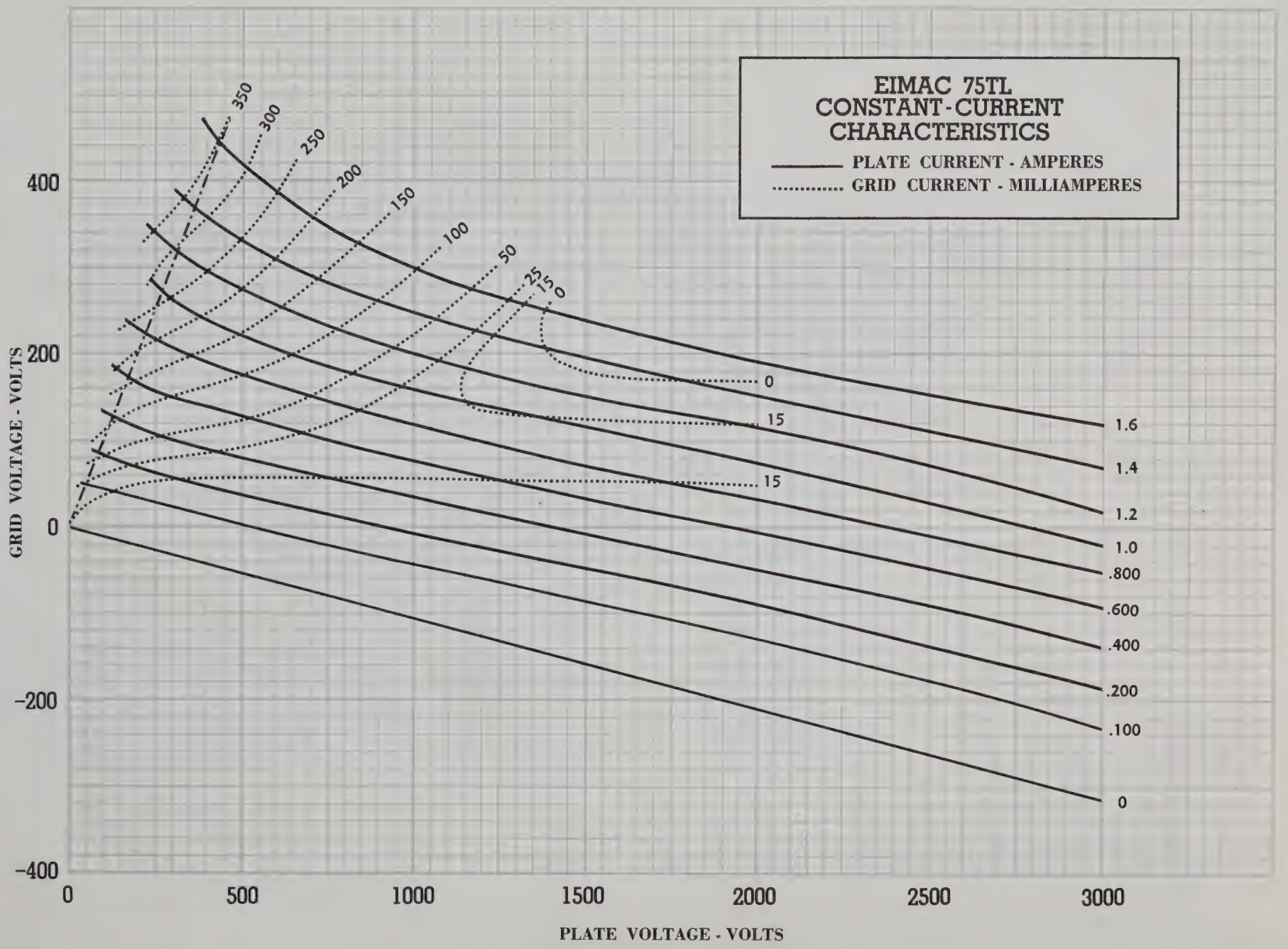
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.








EIMAC 75TL
CONSTANT-CURRENT
CHARACTERISTICS
PLATE CURRENT - AMPERES
GRID CURRENT - MILLIAMPERES
GRID VOLTAGE - VOLTS
400
200
0
-200
-400
0
500
1000
1500
2000
2500
3000
PLATE VOLTAGE - VOLTS
350
300
250
200
150
100
50
25
15
0
0
15
15
1.6
1.4
1.2
1.0
.800
.600
.400
.200
.100
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

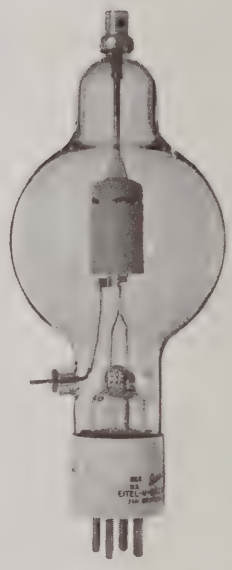
100TH

HIGH-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 100TH is a high-mu power triode having a maximum plate dissipation rating of 100 watts, and is intended for use as an amplifier, oscillator, or modulator. It can be used at its maximum ratings at frequencies as high as 40 MHz.

Cooling of the 100TH is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air circulation by convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

	Nominal	
Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	6.3	amperes
Amplification Factor (Average)	38	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	2.0	pF
Grid-Filament	2.9	pF
Plate-Filament	0.3	pF
Transconductance (i_b=200 ma., E_b=3000v., e_c= —5v.)	4500	μmhos
Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	(Medium 4-pin bayonet, ceramic) RMA type M8-078
Basing	RMA type 2M
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connectors:	
Plate	EIMAC HR-6
Grid	EIMAC HR-2
Maximum Overall Dimensions:	
Length	7.75 inches
Diameter	3.19 inches
Net Weight	4 ounces
Shipping Weight (Average)	1.5 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB$_2$ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	225 MA
PLATE DISSIPATION, PER TUBE	100 WATTS

TYPICAL OPERATION

DC Plate Voltage	1500	2000	2500 Volts
DC Grid Voltage (approx.)*	—20	—35	—50 Volts
Zero-Signal DC Plate Current	80	60	48 Ma
Max-Signal DC Plate Current	320	280	250 Ma
Effective Load, Plate-to-Plate	8800	15,000	22,000 Ohms
Peak AF Grid Input Voltage (per tube)	145	150	155 Volts
Max-Signal Peak Driving Power	18	19	15 Watts
Max-Signal Nominal Driving Power (approx.)	9	9.5	7.5 Watts
Max-Signal Plate Power Output	280	360	425 Watts

*Adjust to give stated zero-signal plate current

(Effective 4-1-67) © 1949, 1967 by Varian

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	3000 VOLTS
DC PLATE CURRENT	-	225 MA
PLATE DISSIPATION	-	100 WATTS
GRID DISSIPATION	-	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	1500	2000	3000 Volts
DC Grid Voltage	—65	—80	—200 Volts
DC Plate Current	190	165	165 Ma
DC Grid Current	48	39	51 Ma
Peak RF Grid Input Voltage	230	230	385 Volts
Driving Power (approx.)	10	8	18 Watts
Grid Dissipation	7	5	10 Watts
Plate Power Input	285	335	500 Watts
Plate Dissipation	100	100	100 Watts
Plate Power Output	185	235	400 Watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

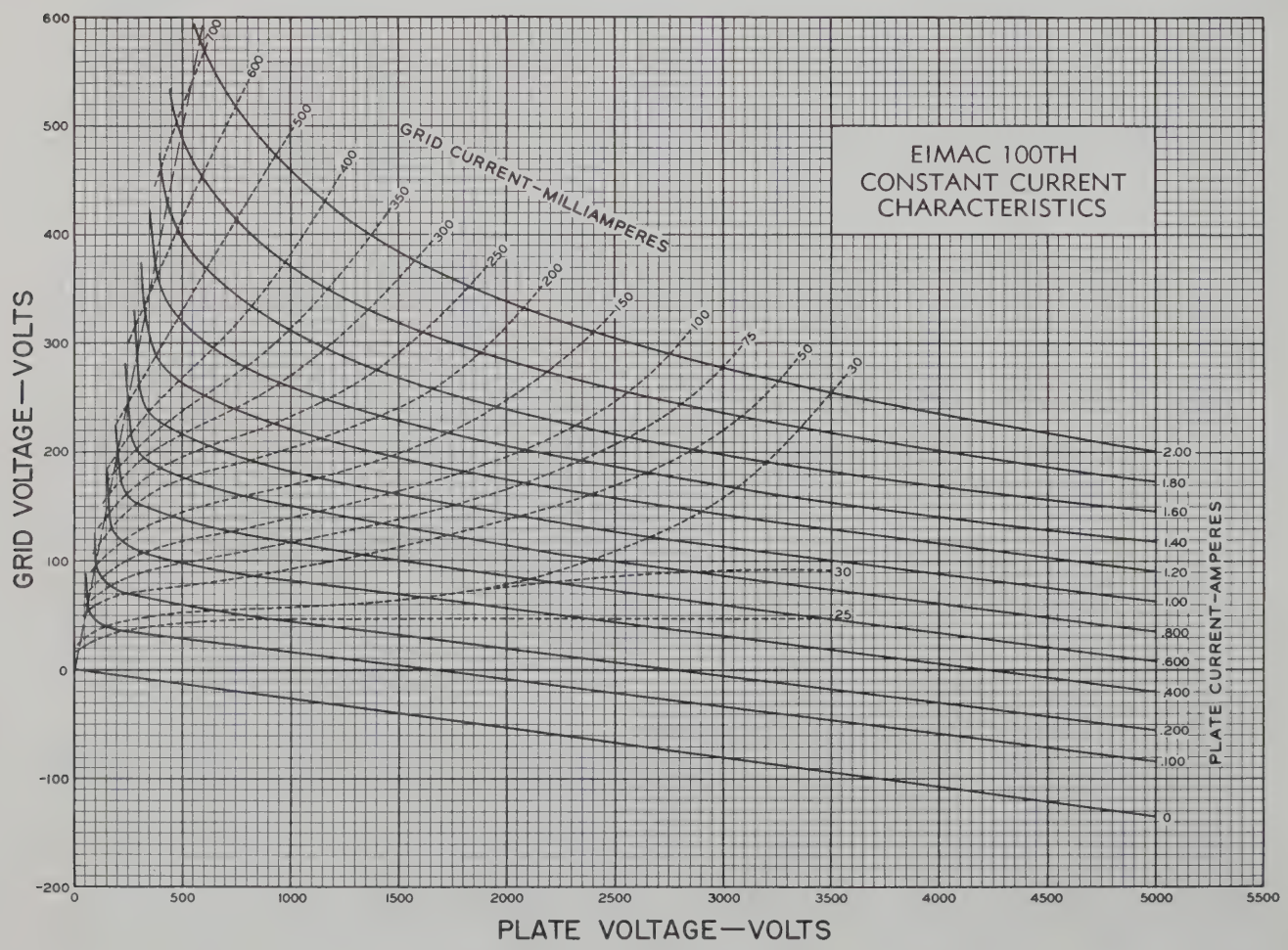
Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	2500 VOLTS
DC PLATE CURRENT	-	180 MA
PLATE DISSIPATION	-	65 WATTS
GRID DISSIPATION	-	20 WATTS

TYPICAL OPERATION

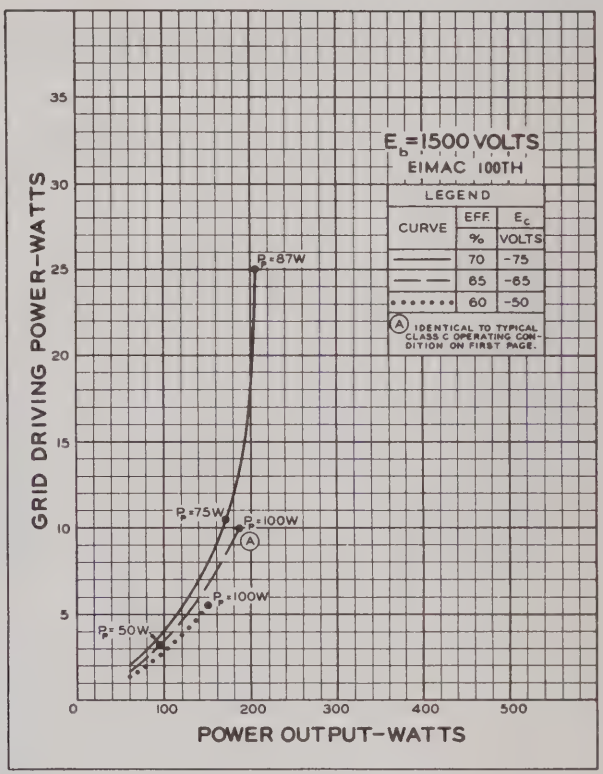
DC Plate Voltage	1500	2000	2500 Volts
DC Grid Voltage	—150	—200	—250 Volts
DC Plate Current	160	150	140 Ma
DC Grid Current	46	41	40 Ma
Peak RF Grid Input Voltage	325	375	425 Volts
Driving Power (approx.)	15	15.5	17 Watts
Grid Dissipation	8	7.3	7 Watts
Plate Power Input	240	300	350 Watts
Plate Dissipation	65	65	65 Watts
Plate Power Output	175	235	285 Watts

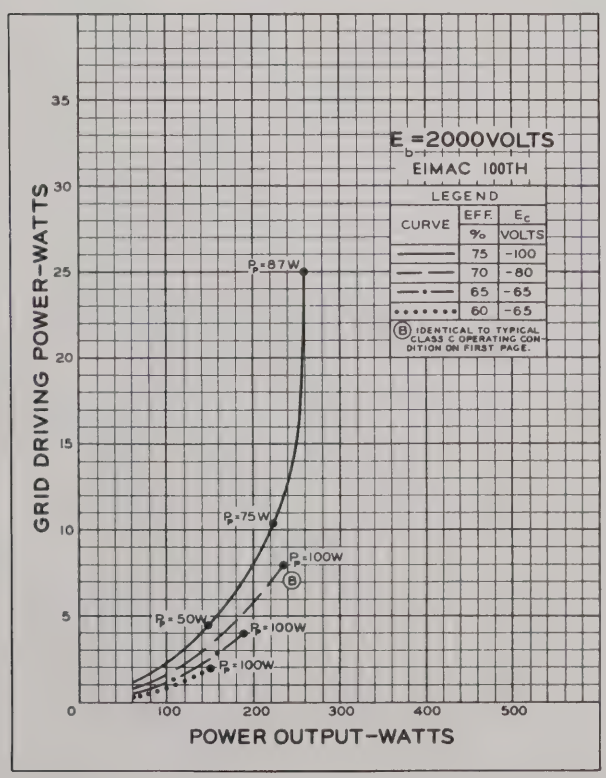


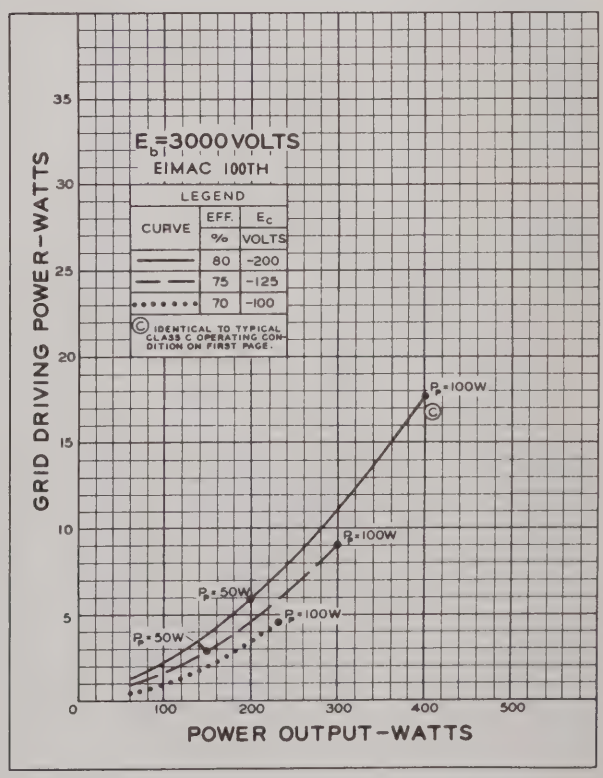
DRIVING POWER vs. POWER OUTPUT

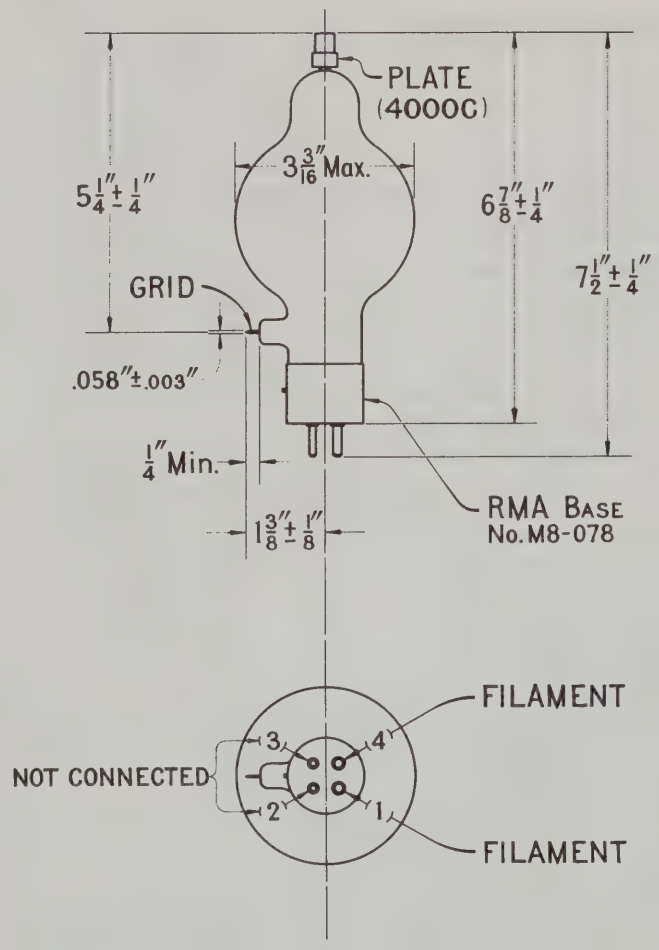
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.

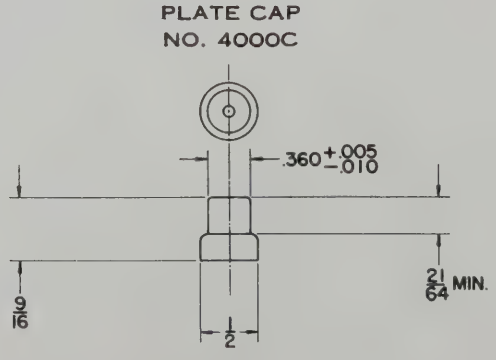







PLATE
(4000C)
3 3/16" Max.
5 1/4" ± 1/4"
6 7/8" ± 1/4"
7 1/2" ± 1/4"
GRID
.058" ± .003"
1/4" Min.
1 3/8" ± 1/8"
RMA BASE
No. M8-078
FILAMENT
NOT CONNECTED
3
4
2
1
FILAMENT


2M
2
3
1
4


PLATE CAP
NO. 4000C
.360 +.005 -.010
21/64 MIN.
9/16
1/2
GRID CAP
(SEE TUBE OUTLINE DRAWING)

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

152TL

LOW-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten		
Voltage	5.0 or 10.0	volts
Current	12.5 or 6.25	amperes
Amplification Factor (Average)	12	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	4.4	pF
Grid-Filament	4.5	pF
Plate-Filament	0.7	pF
Transconductance (i_b = 500 ma., E_b = 3000V, E_c = −85V)	7150	umhos



MECHANICAL

Base	Special 4 pin, No. 5000B	
Basing	RMA type 4BC	
Maximum Overall Dimensions		
Length	7.625	inches
Diameter	2.563	inches
Net Weight	7	ounces
Shipping weight (Average)	2.0	pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

	ZERO GRID CURRENT OPERATION — 2 TUBES			TYPICAL OPERATION 2 TUBES			MAX. RATING	
DC Plate Voltage	1500	2000	3000	1500	2000	3000	3000	volts
Max.-Signal DC Plate Current, per tube*	—	—	—	—	—	—	450	ma.
Plate Dissipation, per tube*	—	—	—	—	—	—	150	watts
DC Grid Voltage (approx.)	-105	-160	-260	-105	-160	-260		volts
Peak AF Grid Input Voltage	210	320	520	500	620	675		volts
Zero-Signal DC Plate Current	135	100	65	135	100	65		ma.
Max.-Signal DC Plate Current	286	260	220	570	500	335		ma.
Max.-Signal Driving Power (approx.)	—	—	—	15	13	3		watts
Effective Load, Plate-to-Plate	5100	10500	24000	5500	9000	20400		ohms
Max.-Signal Plate Power Output	130	220	370	560	700	700		watts

*Averaged over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class C *Telegraphy

(Key down conditions without modulation)

	TYPICAL OPERATION — 1 TUBE			MAX. RATING	
DC Plate Voltage	1500	2000	3000	3000	volts
DC Plate Current	333	300	250	450	ma.
DC Grid Current	45	42	40	75	ma.
DC Grid Voltage	-250	-300	-400		volts
Plate Power Output	350	450	600		watts
Plate Input	500	600	750		watts
Plate Dissipation	150	150	150	150	watts
Peak RF Grid Input Voltage (approx.)	400	455	550		volts
Driving Power (approx.)	16	18	20		watts

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Revised 4-1-67) © 1944, 1967 by Varian

Printed in U.S.A.

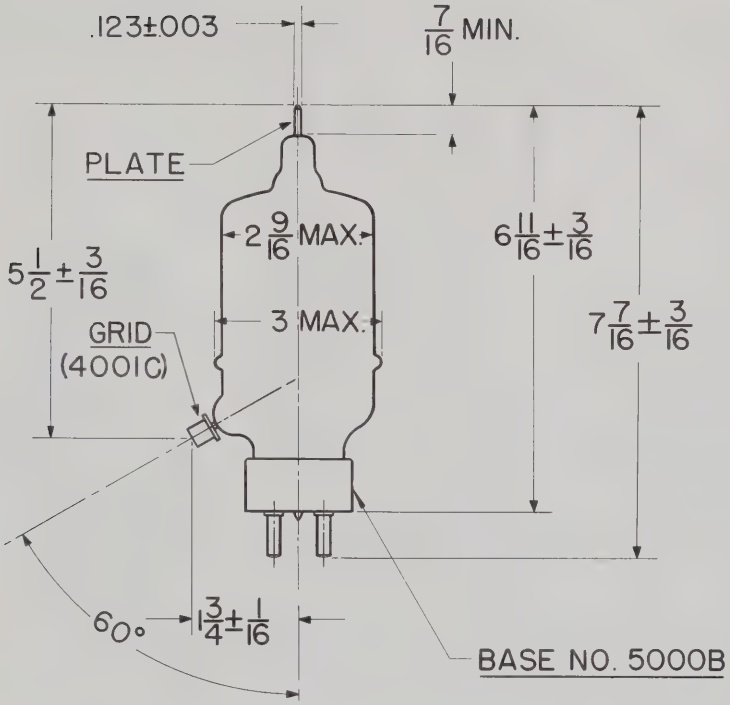
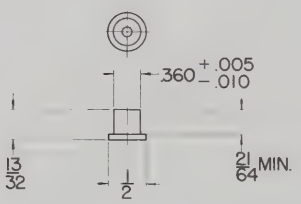
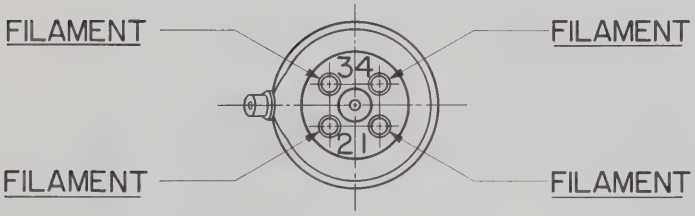


PLATE CAP

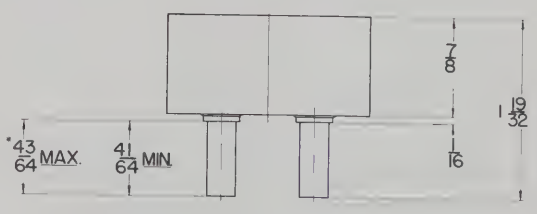
(SEE TUBE OUTLINE DRAWING)

GRID CAP
NO. 4001C



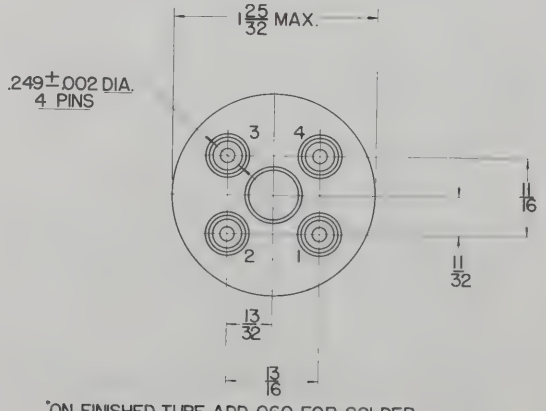


BASE NO. 5000B



4BC



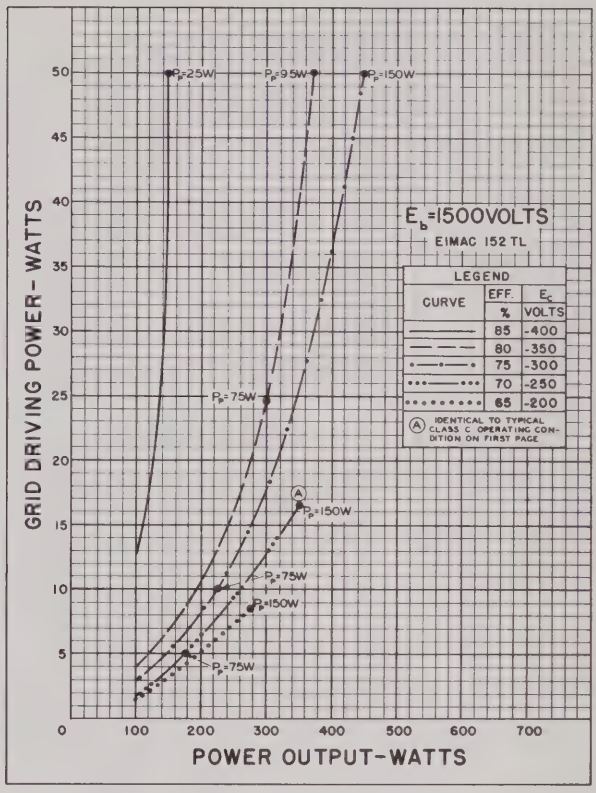


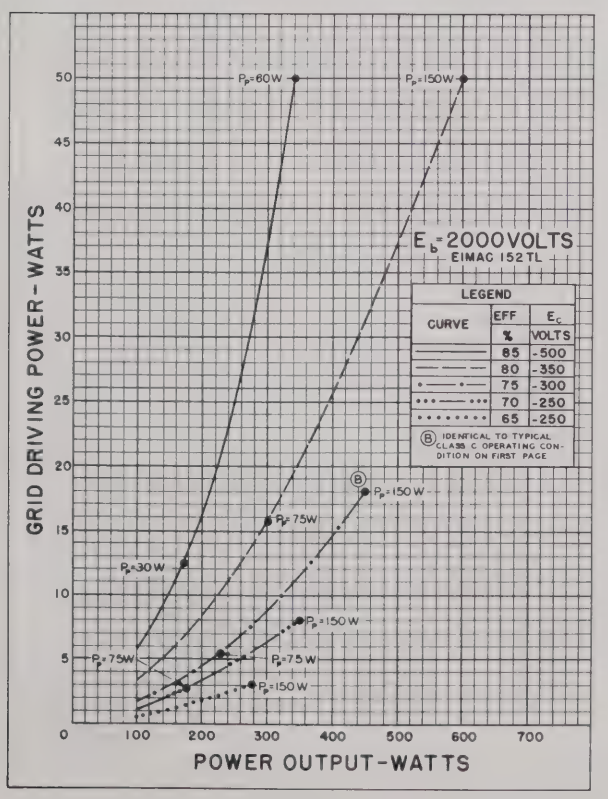
*ON FINISHED TUBE ADD .060 FOR SOLDER

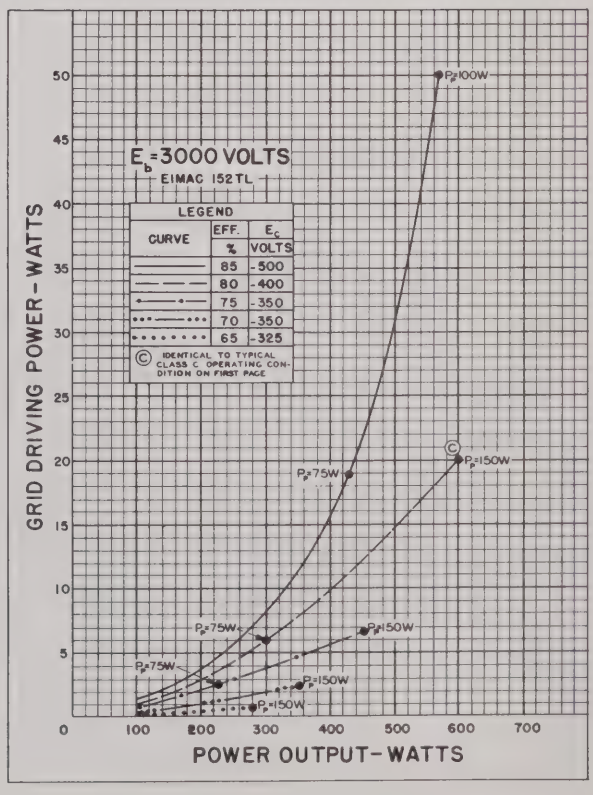
DRIVING POWER vs. POWER OUTPUT

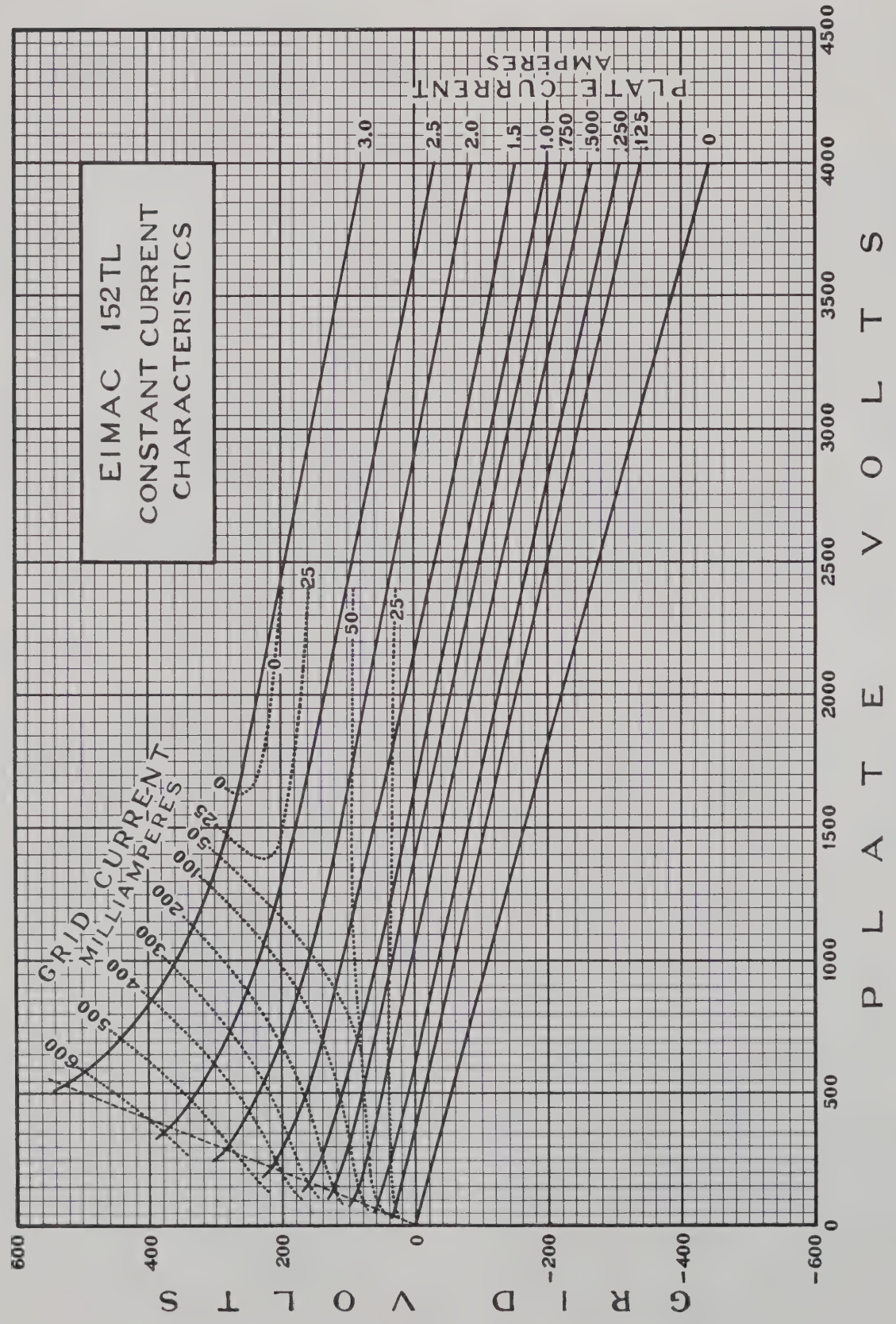
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.









Printed in U.S.A. 1012

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

304TH

MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 304TH is a medium-mu power triode intended for use as an amplifier, oscillator or modulator. It has a maximum plate-dissipation rating of 300 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 40 MHz.

The 304TH in Class-C rf service will deliver up to 1200 watts plate power output with 53 watts driving power. Two 304TH's in Class-AB_2 modulator service will deliver up to 1400 watts maximum-signal plate power output with 14 watts nominal driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0 or 10.0	volts
Current	25.0 or 12.5	amperes
Amplification Factor (Average)	20	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	10.2	pF
Grid-Filament	13.5	pF
Plate-Filament	0.7	pF
Transconductance (I_b=1.0 amp., E_b=3000 v.)	16,700	μmhos
Highest Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	Special 4-pin
Basing	See outline drawing
Socket	Johnson type No. 124-213 or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat-Dissipating Connectors:	
Plate	EIMAC HR-7
Grid	EIMAC HR-6
Maximum Over-all Dimensions:	
Length	7.63 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	3.0 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy (Key-down conditions, one tube)

MAXIMUM RATINGS (Frequencies up to 40 MHz)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS
GRID DISSIPATION	60 WATTS

TYPICAL OPERATION (Frequencies up to 40 MHz)

DC Plate Voltage	1500	2000	3000 volts
DC Grid Voltage	−125	−200	−300 volts
DC Plate Current	665	600	500 ma
DC Grid Current*	115	125	135 ma
Peak RF Grid Voltage	250	325	395 volts
Driving Power*	25	39	53 watts
Grid Dissipation*	16	12	16 watts
Plate Dissipation	300	300	300 watts
Plate Power Input	1000	1200	1500 watts
Plate Power Output	700	900	1200 watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 40 MHz)

DC PLATE VOLTAGE	2500 VOLTS
DC PLATE CURRENT	750 MA
PLATE DISSIPATION	200 WATTS
GRID DISSIPATION	60 WATTS

TYPICAL OPERATION (Frequencies up to 40 MHz)

DC Plate Voltage	1500	2000	2500 volts
DC Grid Voltage	−200	−300	−350 volts
DC Plate Current	420	440	400 ma
DC Grid Current*	55	60	60 ma
Peak RF Grid Voltage	330	440	485 volts
Driving Power*	18	26	29 watts
Grid Dissipation*	7	8	8 watts
Plate Dissipation	200	200	200 watts
Plate Power Input	700	880	1000 watts
Plate Power Output	500	680	800 watts

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_2

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1500	2000	3000 volts
DC Grid Voltage[1]	−65	−90	−150 volts
Zero Signal DC Plate Current	265	200	135 ma
Max. Signal DC Plate Current	1065	900	665 ma
Effective Load Plate-to-Plate	2840	4820	10,200 ohms
Peak AF Grid Voltage (per tube)	165	175	210 volts
Max. Signal Peak Driving Power*	50	37	27 watts
Max. Signal Nominal Driving Power*	25	19	14 watts
Max. Signal Plate Power Input	1600	1800	2000 watts
Max. Signal Plate Power Output	1000	1200	1400 watts

*Approximate values.
[1]Adjust to give stated Zero-Signal DC Plate Current.

If it is desired to operate this tube under conditions widely different from those given under "Typical Operation," possibly exceeding the maximum ratings given for CW service, write Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, Calif. for information and recommendations.

(Effective 4-1-67) © 1953, 1967 by Varian

Printed in U.S.A.

MECHANICAL

Mounting—The 304TH must be mounted vertically, base down or up. The plate and grid leads should be flexible, and the tube must be protected fom vibration and shock.

Cooling—Heat Dissipating Connectors (EIMAC HR-7 and HR-6 or equivalent) must be used at the plate and grid terminals of the 304TH. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 MHz. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling.

The temperature of the plate and grid seals must not be allowed to exceed 225°C. One method of measuring these temperatures is by the use of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N.Y.

ELECTRICAL

Filament Voltage—The filaments of the 304TH may be operated either at 10.0 volts when connected in series or at 5.0 volts when connected in parallel (see basing diagram). For maximum tube life the filament voltage should be maintained at the rated value. Variations must not be allowed to exceed ±5%.

Bias Voltage — When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

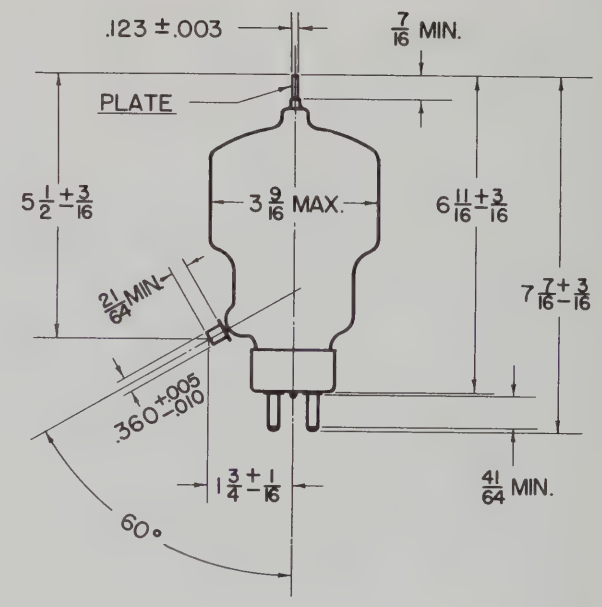
Grid Dissipation — The power dissipated by the grid of the 304TH must not exceed 60 watts. Grid dissipation may be calculated from the following expression.

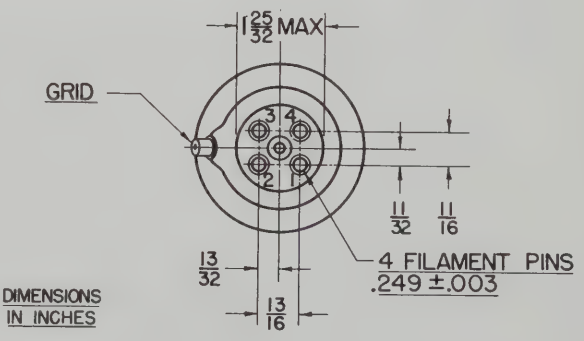
$$P_g = e_{cmp} I_c$$

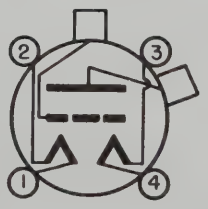
where P_g=grid dissipation,
e_{cmp}=peak positive grid voltage, and
I_c=dc grid current.

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation — The plates of the 304TH operate at a visible red color at the maximum rated dissipation of 300 watts. Plate dissipation in excess of the maximum rating is permissable only for short periods of time, such as during tuning procedures.



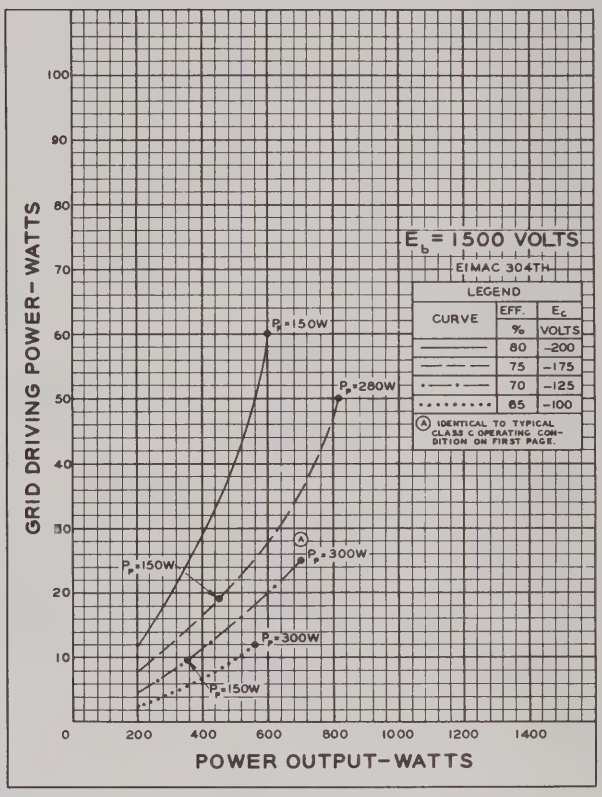


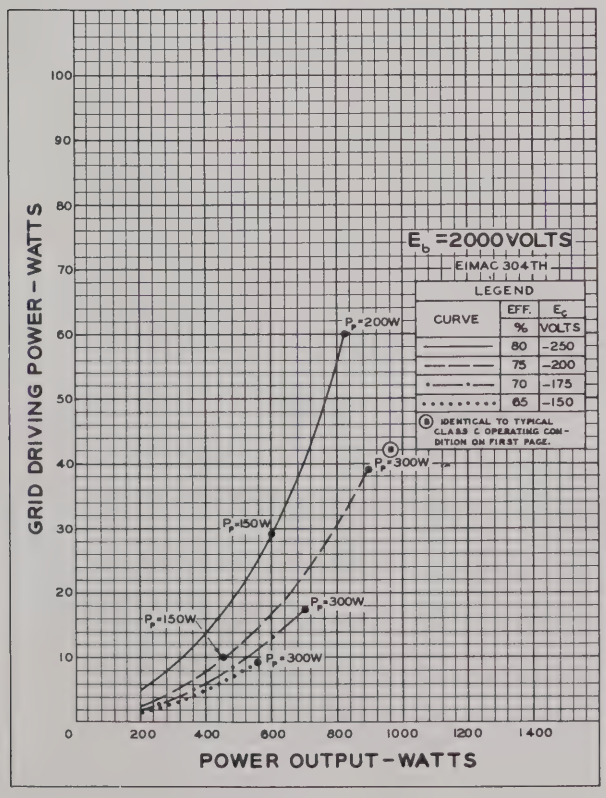


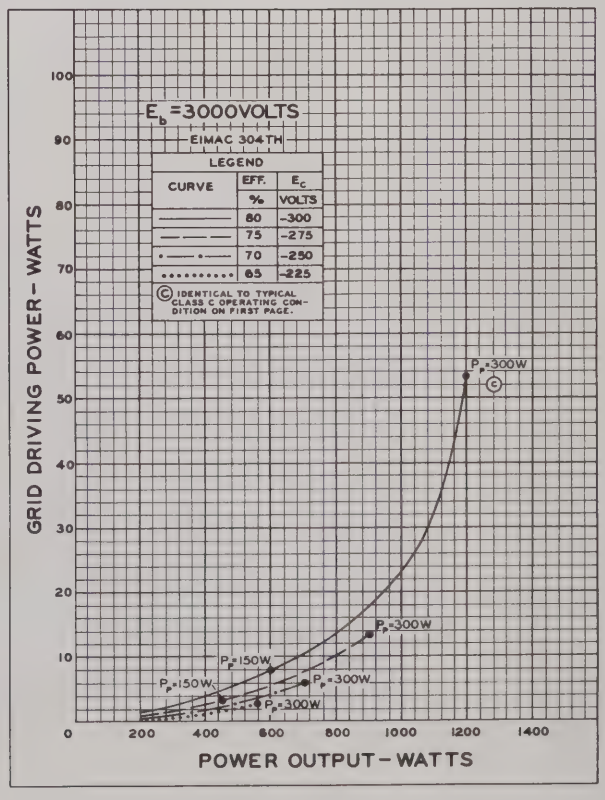
DRIVING POWER vs. POWER OUTPUT

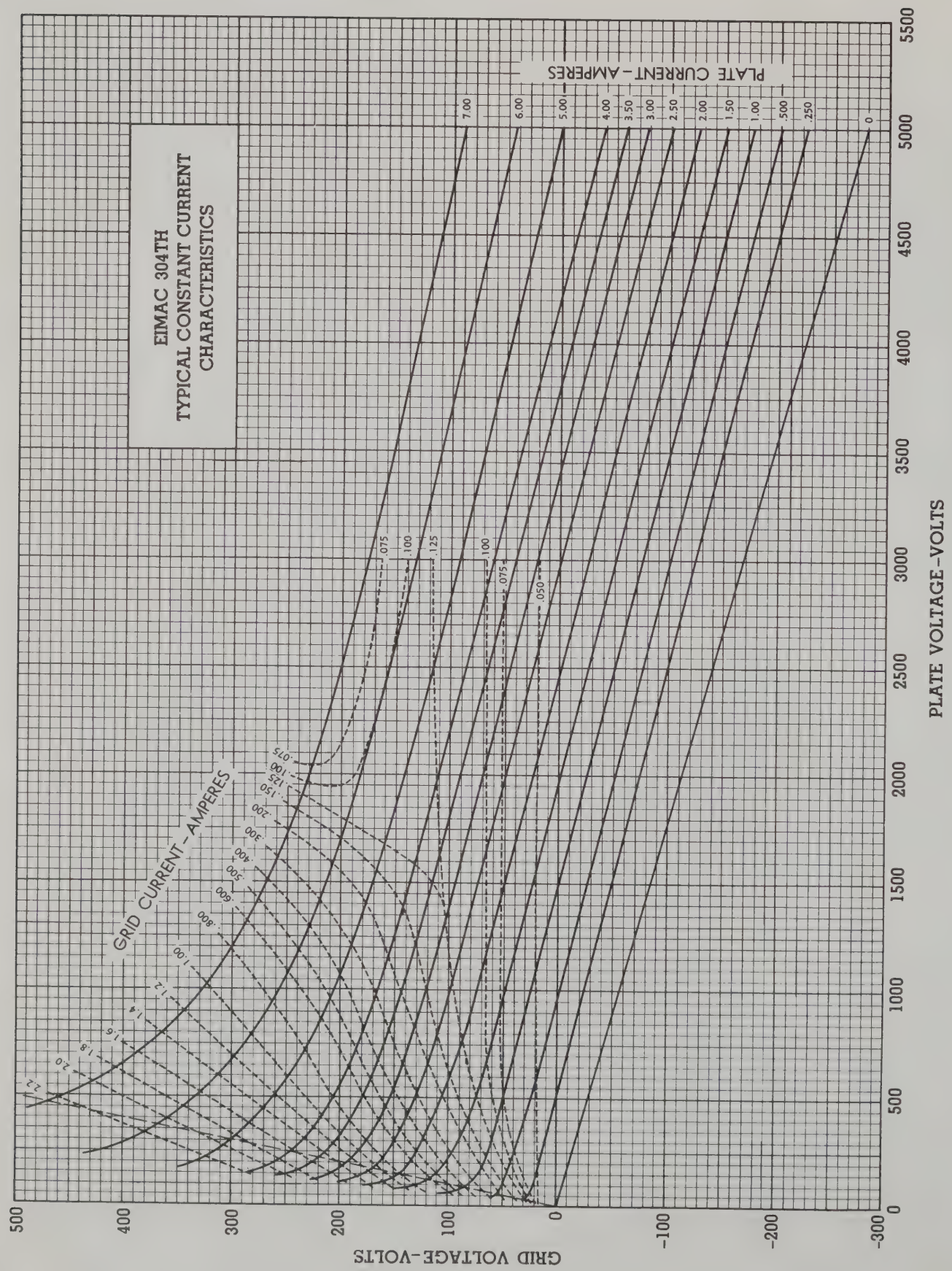
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.








EIMAC 304TH
TYPICAL CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT – AMPERES
7.00
6.00
5.00
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.500
.250
0
GRID CURRENT – AMPERES
.075
.100
.125
.150
.200
.300
.400
.500
.600
.800
1.00
1.2
1.4
1.6
1.8
2.0
2.2
.050
.075
.100
PLATE VOLTAGE–VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
GRID VOLTAGE–VOLTS
500
400
300
200
100
0
-100
-200
-300

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CX1500B

RADIAL BEAM POWER TETRODE

JEDEC DESIGNATION

8660

The EIMAC 4CX1500B is ceramic and metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 1500 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 4CX1500B especially suitable for radio-frequency and audio-frequency linear amplifier service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	9.0		11.0	amperes
Transconductance:				
(I_b=0.5 amperes, E_{c2}=225 volts)		30,000		umhos

Direct Interelectrode Capacitances, Grounded Cathode:*	Min.	Nom.	Max.	
Input	75		88	pF
Output	10.8		12.8	pF
Feedback			.03	pF
Direct Interelectrode Capacitances, Grounded Grid and Screen:*				
Input		38		pF
Output		12		pF
Feedback			0.005	pF

*In Shielded Fixture

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (Approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	.900 AMP
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	12 WATTS
CONTROL GRID DISSIPATION	1 WATT

*Adjust to the specified Zero-Signal Plate Current.
**The driving power specified includes the power dissipated in a 1000 ohm swamping resistor between the control grid and the cathode.
***The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies below 30 MHz)

Class AB_2, Grid Driven, Peak Envelope or Modulation Crest Conditions

DC Plate Voltage	2500	2750	2900	Volts
DC Screen Voltage	225	225	225	Volts
DC Grid Voltage*	—34	—34	—34	Volts
Zero-Signal DC Plate Current	300	300	300	mA
Single-Tone DC Plate Current	720	755	710	mA
Two-Tone DC Plate Current	530	555	542	mA
Single-Tone DC Grid Current	1.3	0.95	0.53	mA
Two-Tone DC Grid Current	0.06	0.20	0.06	mA
Single-Tone DC Screen Current	—7	—14	—15	mA
Two-Tone DC Screen Current	—11	—11	—11	mA
Peak RF Grid Voltage	46	45	41	Volts
Driving Power**	1.5	1.5	1.5	Watts
Useful Output Power	900	1100	1100	Watts
Resonant Load Impedance	1900	1900	2200	Ohms
Intermodulation Distortion Products***— 3rd order	—38	—40	—43	db
5th order	—47	—48	—47	db

(Revised 6-1-67) © 1966, 1967 by Varian

Printed in U.S.A.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	.900 AMP
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	1.0 WATTS

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Sinusoidal wave, 2 tubes unless noted)

DC Plate Voltage	2000	2500	2900	Volts
DC Screen Voltage	325	325	325	Volts
DC Grid Voltage**	—60	—60	—60	Volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.68	1.69	1.69	Amps
Zero-Signal DC Screen Current*	—30	—25	—20	mA
Max.-Signal DC Screen Current*	—27	—33	—32	mA
Effective Load, Plate to Plate	1948	2715	3333	Ohms
Driving Power	0	0	0	Watts
Max.-Signal Plate Output Power	1604	2258	2774	Watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

Cooling — The maximum temperature rating for the anode core of the 4CX1500B is 250°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-to-metal seals to below 250°C. Air flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). Tube mounted in recommended socket and chimney.

	Sea Level		10,000 feet	
Plate Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1000	18	.23	24	.31
1500	34	.60	45	.80

*Since the power dissipated by the heater represents about 60 watts and since grid plus screen dissipation can, under some conditions, represent another 13 watts, allowance has been made in preparing this tabulation for an additional 73 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

Heater — The rated heater voltage for the 4CX1500B is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Intermodulation Distortion — The Radio Frequency Linear Amplifier operating conditions including the distortion data are the results of actual operation in a neutralized grid-driven amplifier. Plots of IM distortion versus power output under two-tone conditions, as a function of zero-signal plate current, are included to illustrate the effect of this parameter upon distortion. Because the 4CX1500B has very low grid interception it is possible to drive the grid positive without any adverse effects upon the distortion level or upon the driver. Class AB_2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX1500B be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.

Control-Grid Operation — The control grid dissipation rating of the 4CX1500B is 1 watt. The design features which make the 4CX1500B such an extremely linear tube also contribute to very low grid interception. It will be found that the grid will be driven into the positive grid region in the typical operation of the tube. The grid current will usually be less than 1.0 milliampere.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1500B and, under some operating conditions, indicated negative screen currents in the order of 35 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1500B is 12 watts and

the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

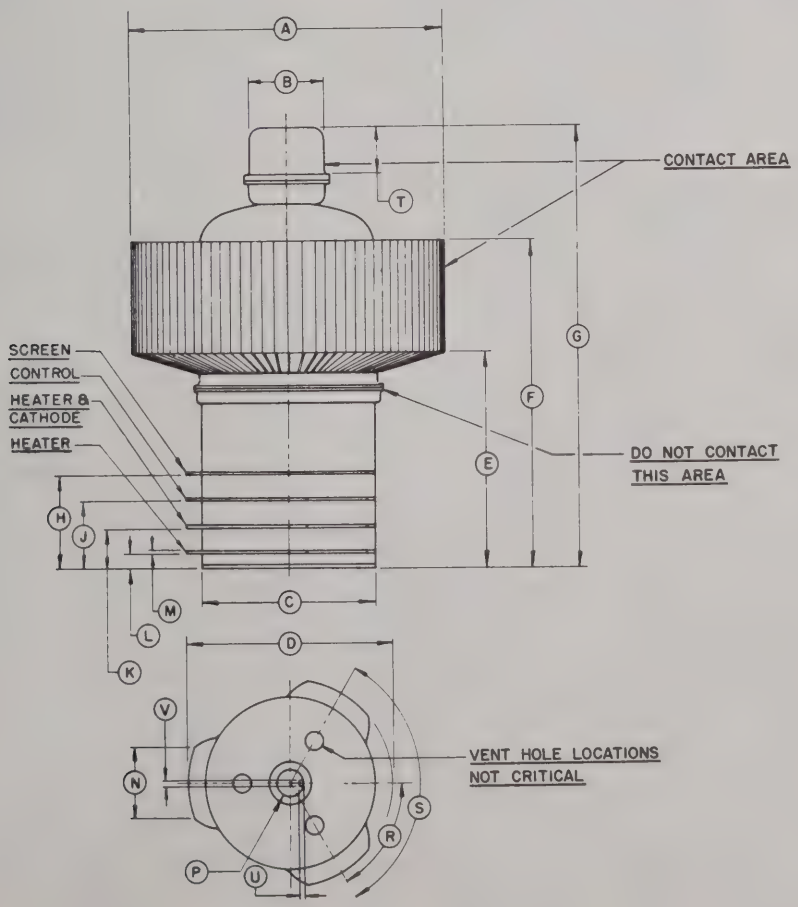
The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

Plate Operation — The maximum rated plate dissipation power is 1500 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

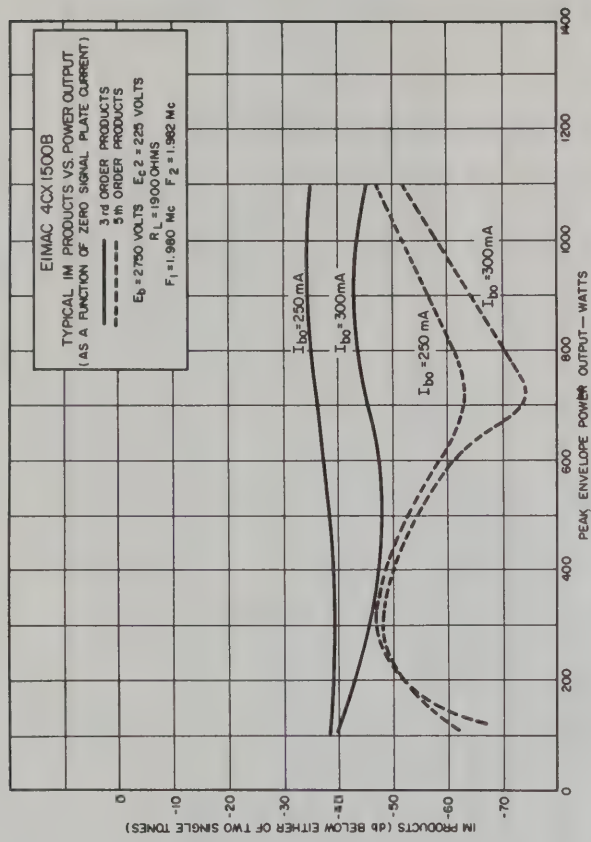
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

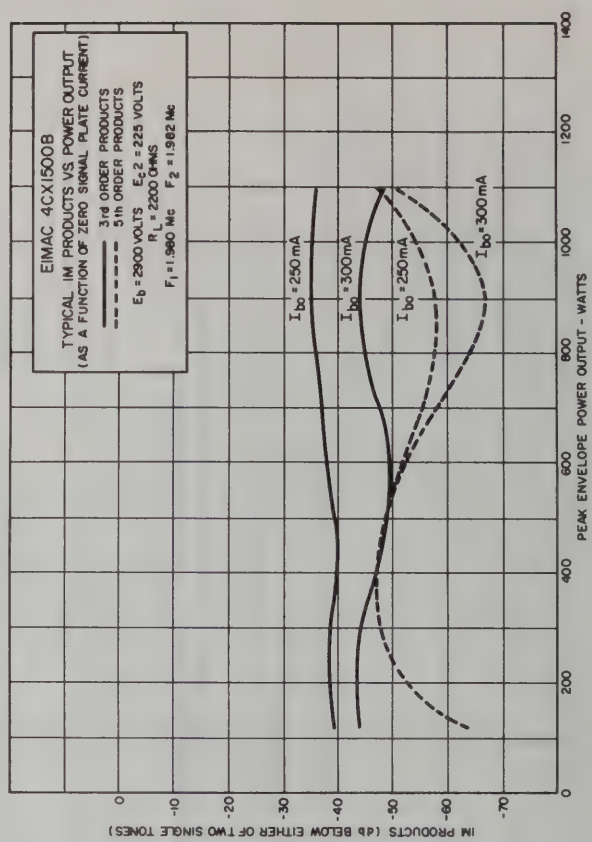
Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

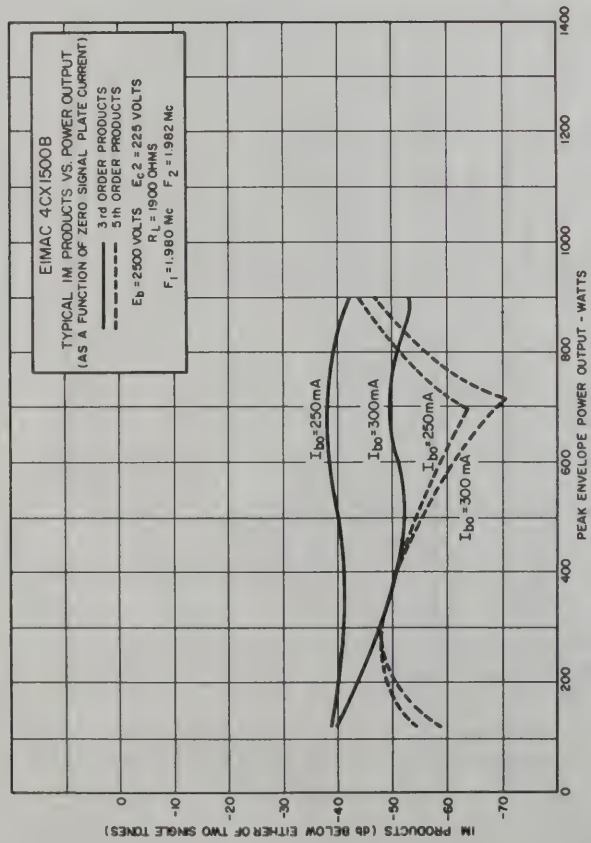
Special Applications — If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Product Manager, EIMAC Division of Varian Associates, San Carlos, California, for information and recommendations.

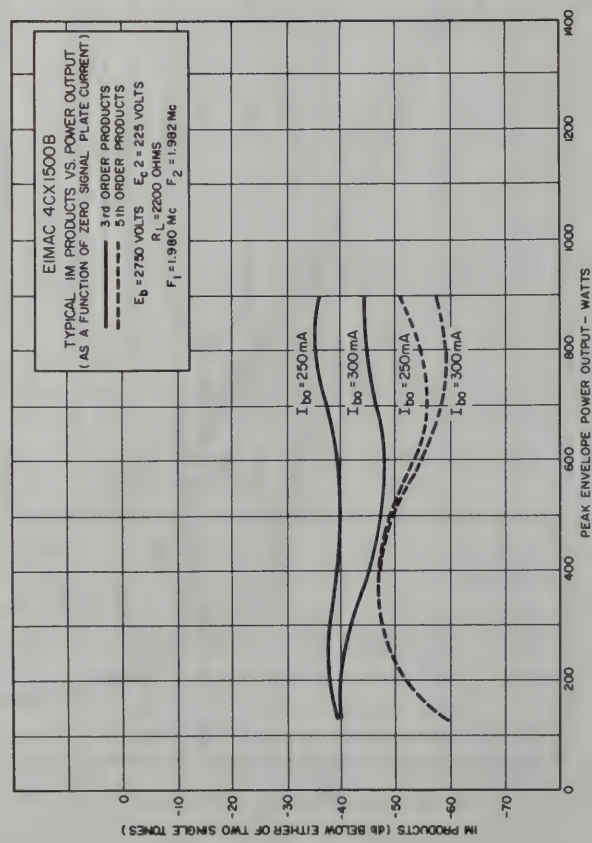


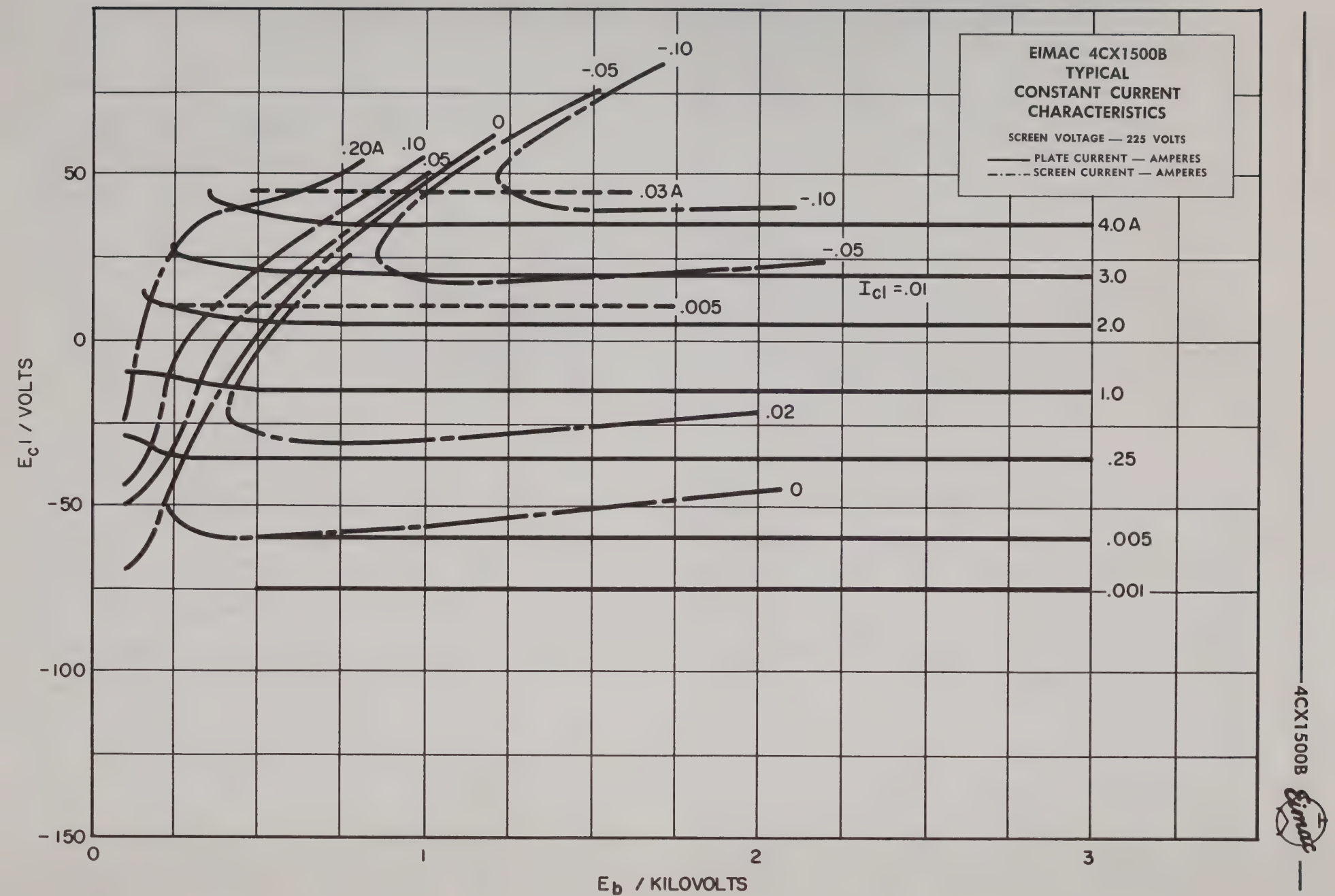
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.

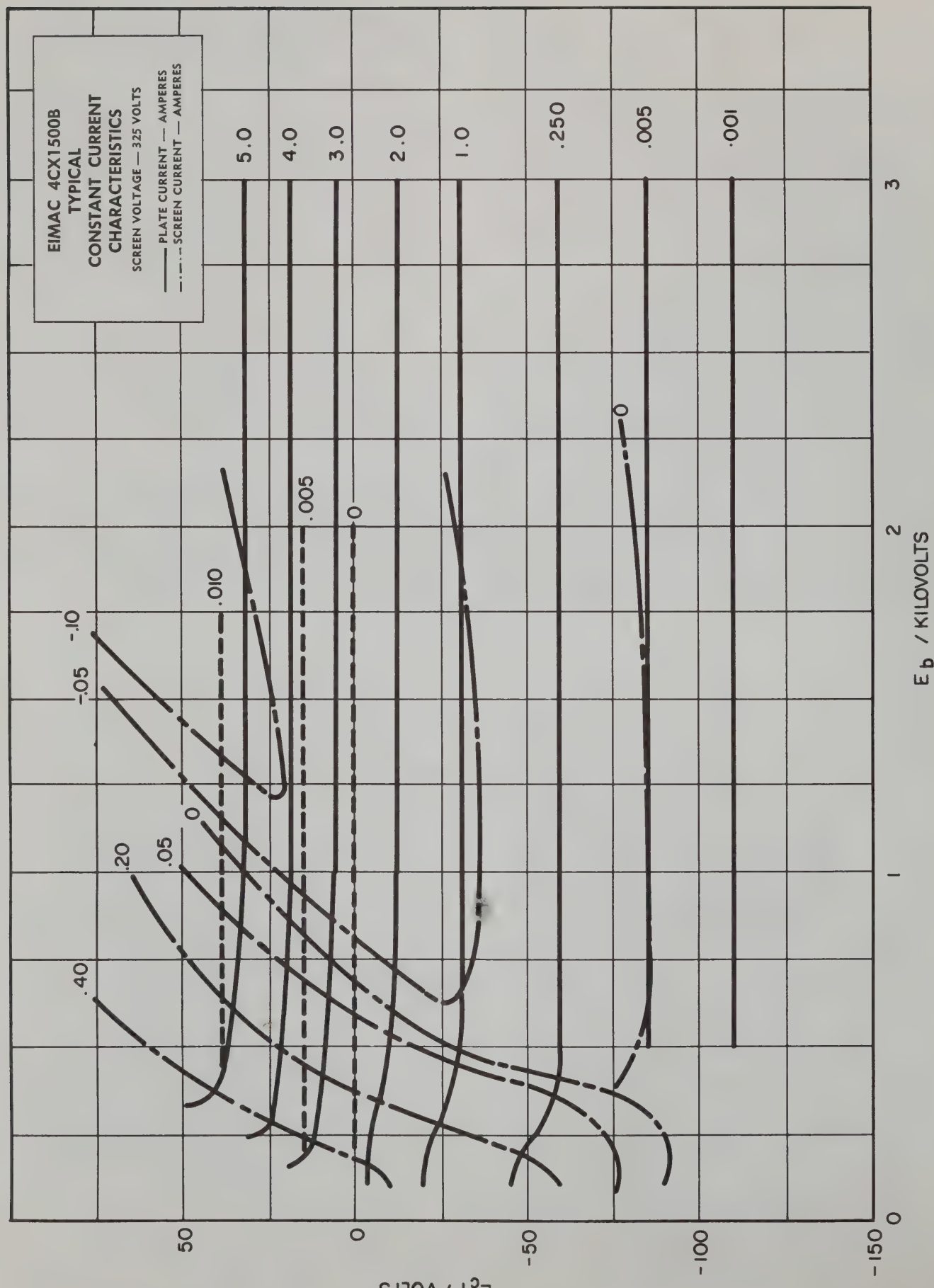

EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250 mA
Ibo = 300 mA
Ibo = 250 mA
Ibo = 300 mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT — WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2900 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2500 VOLTS Ec2 = 225 VOLTS
RL = 1900 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL IM PRODUCTS VS. POWER OUTPUT
(AS A FUNCTION OF ZERO SIGNAL PLATE CURRENT)
3rd ORDER PRODUCTS
5th ORDER PRODUCTS
Eb = 2750 VOLTS Ec2 = 225 VOLTS
RL = 2200 OHMS
F1 = 1.980 Mc F2 = 1.982 Mc
Ibo = 250mA
Ibo = 300mA
Ibo = 250mA
Ibo = 300mA
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT - WATTS


EIMAC 4CX1500B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 225 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
-.10
-.05
0
.20A
.10
.05
.03A
-.10
4.0A
-.05
3.0
I_{c1} =.01
.005
2.0
1.0
.02
.25
0
.005
.001
50
0
-50
-100
-150
0
1
2
3
E_{c1} / VOLTS
E_b / KILOVOLTS
4CX1500B
Eimac


EIMAC 4CX1500B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
5.0
4.0
3.0
2.0
1.0
.250
.005
.001
.010
.005
0
-.10
-.05
0
.05
.20
.40
0
.005
0
50
0
-50
-100
-150
E_{c1} / VOLTS
0
1
2
3
E_b / KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8169
4CX3000A
RADIAL-BEAM POWER TETRODE

The EIMAC 8169/4CX3000A is a ceramic and metal power tetrode designed to be used as a Class-AB_1 linear amplifier in audio or radio-frequency applications. Its characteristics of low intermodulation distortion make it especially suitable for single sideband service.

This tube is unique in that a production test is included to insure minimum distortion products. The 8169/4CX3000A must produce a *minimum* of 5300 watts in Class AB_1 service with IM distortion at least 32 db down, 3rd order.

The tube is also recommended for use as a Class-C radio-frequency power amplifier and plate-modulated radio-frequency power amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		9.0		volts
Current	39.5		43.5	amps
Amplification Factor (Grid Screen)		5.5		
Frequency For Maximum Ratings			150	MHz
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	120		140	pF
Output	10.5		14.5	pF
Feedback			1.4	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	55	67	pF
Output	10.5	14.5	pF
Feedback		0.2	pF

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	EIMAC SK-1400 series
Recommended Air Chimney	EIMAC SK-1406
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	7.9 inches
Diameter	4.6 inches
Cooling	Forced air
Net Weight	5.5 pounds
Shipping Weight (Approximate)	10 pounds

(Revised 5-1-67) © 1965, 1967 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	3000 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	—280	—300 volts
DC Plate Current	1.9	1.9 amps
DC Screen Current	250	230 mA
DC Grid Current	100	100 mA
Peak RF Grid Voltage	385	405 volts
Driving Power	39	41 watts
Plate Dissipation	1900	2300 watts
Plate Output Power	7600	11,000 watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC SCREEN VOLTAGE	600 VOLTS
DC PLATE CURRENT	1.4 AMPS
PLATE DISSIPATION*	2000 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS

*Corresponds to 3000 watts at 100 percent sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	5000 volts
DC Screen Voltage	500 volts
Peak AF Screen Voltage (For 100% Modulation)	415 volts
DC Grid Voltage	—375 volts
DC Plate Current	1.4 amps
DC Screen Current	170 mA
DC Grid Current	68 mA
Peak RF Grid Voltage	455 volts
Grid Driving Power	31 watts
Plate Dissipation	1250 watts
Plate Output Power	5750 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	6000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	3500 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS

*Per tube
**Approximate values

TYPICAL OPERATION (Two Tubes), Class AB_1

DC Plate Voltage	5000	6000 volts
DC Screen Voltage	850	850 volts
DC Grid Voltage*	—180	—200 volts
Max-Signal Plate Current	3.6	3.1 amps
Zero-Signal Plate Current	1.0	0.7 amp
Max-Signal Screen Current**	170	120 mA
Zero-Signal Screen Current	0	0 mA
Peak AF Driving Voltage*	155	175 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	3000	4160 ohms
Max-Signal Plate Dissipation*	3300	3100 watts
Max-Signal Plate Output Power	11,400	12,400 watts

NOTE: In Class AB operation, maximum plate voltage and plate current must not be applied simultaneously, as plate dissipation will be exceeded.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	3500 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS

*Approximate values

These values are obtained in existing equipment. A design test is performed on a sampling basis, insuring that the 4CX3000A will perform as indicated with respect to IM distortion products and power output.

TYPICAL OPERATION Class AB_1, Grid Driven

DC Plate Voltage	5000 volts
DC Screen Voltage	850 volts
DC Grid Voltage*	180 volts
Zero-Signal DC Plate Current	0.5 amp
Single-Tone DC Plate Current	1.65 amps
Single-Tone DC Screen Current	25 mA
Two-Tone DC Plate Current	1.10 amps
Two-Tone DC Screen Current	20 mA
Peak RF Grid Voltage	155 volts
Driving Power	0 watts
Peak Envelope Useful Output Power	5300 watts
Resonant Load Impedance	1700 ohms
Intermodulation Distortion Products (without negative feedback)	—32 db

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed.

APPLICATION

MECHANICAL

Mounting — The 4CX3000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket — The EIMAC SK-1400A and SK-1470A sockets have been designed especially for the 4CX3000A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through an Air Chimney, the SK-1406, and through the anode cooling fins.

Cooling — The maximum temperature rating for the external surfaces of the 4CX3000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 200°C in 40°C ambient air are tabulated below (for operation below 30 megahertz).

Plate Dissipation* (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (inches of water)
1500	36.5	0.3	53	0.4
2500	60	0.8	88	1.2
3500	86	1.6	125	2.3

***Since the power dissipated by the filament represents about 450 watts and since grid-plus-screen dissipation can, under some conditions, represent another 225 watts, allowance has been made in preparing this tabulation for an additional 675 watts dissipation.**

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX3000A is 9.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Intermodulation Distortion — The operating conditions including distortion data are the results of actual operation in a neutralized, grid-driven amplifier. This test is performed on sample tubes from regular production runs. A plot of IM distortion versus power output under two-tone condition for a typical tube is shown on the next page.

Control Grid Operation — The rated dissipation of the grid is 50 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

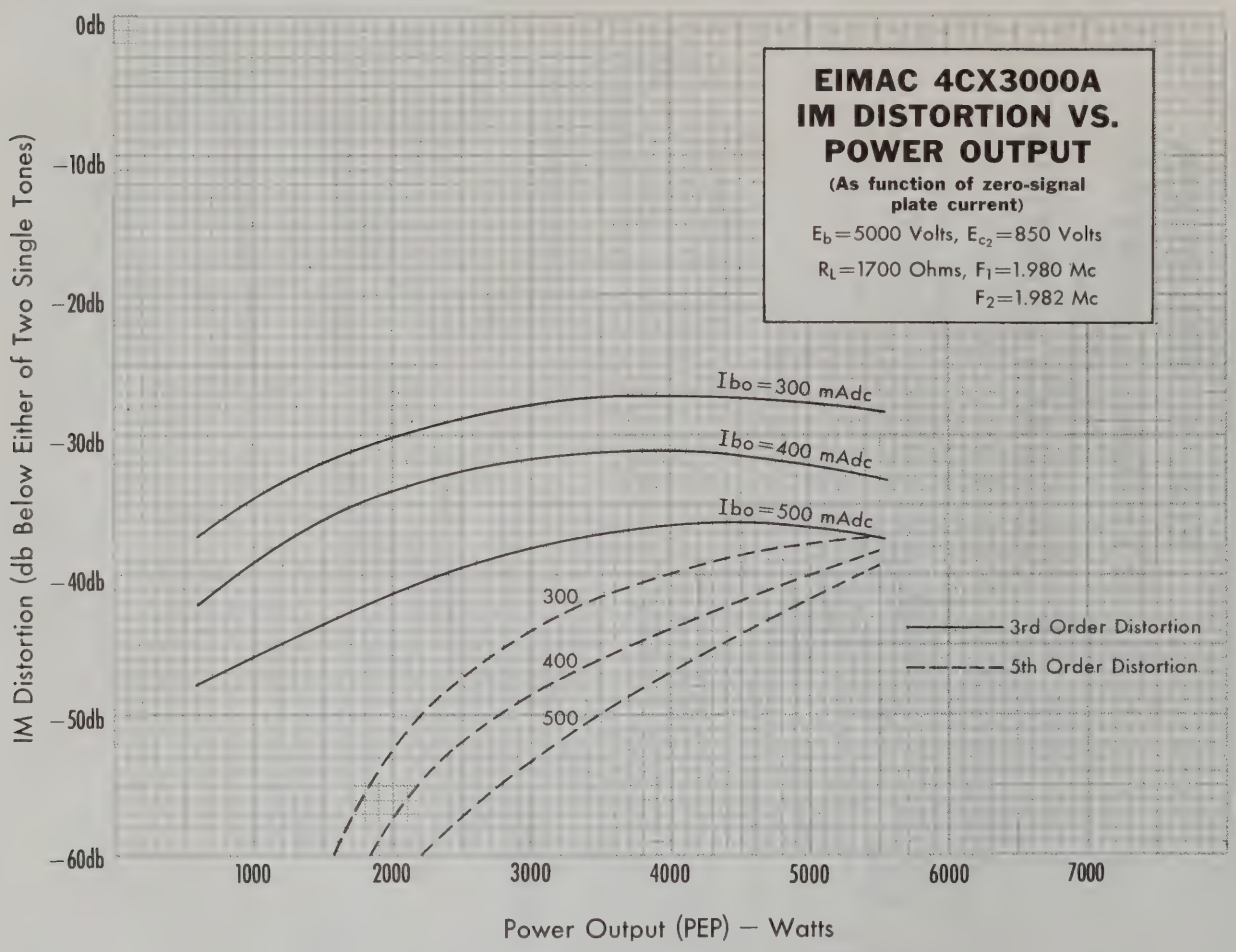
Screen-Grid Operation — The power dissipated by the screen of the 4CX3000A must not exceed 175 watts.

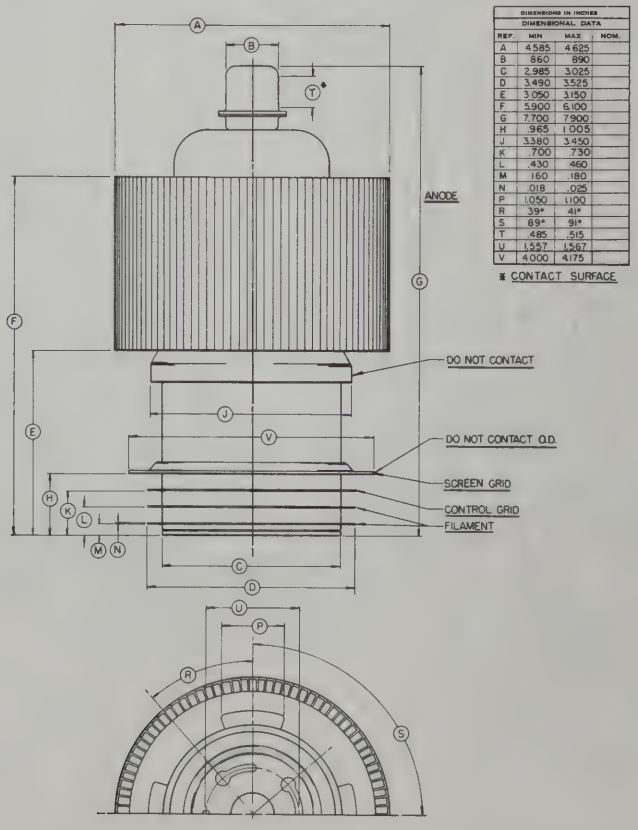
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 175 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation ratings for the 4CX3000A are 2000 watts for Class-C plate-modulated service and 3000 watts for Class-C telegraphy. In Class-AB operation this rating has been increased to 3500 watts to allow more input. In any Class-AB application maximum plate current and maximum plate voltage should not be applied simultaneously as the plate-dissipation rating would be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Division or Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.



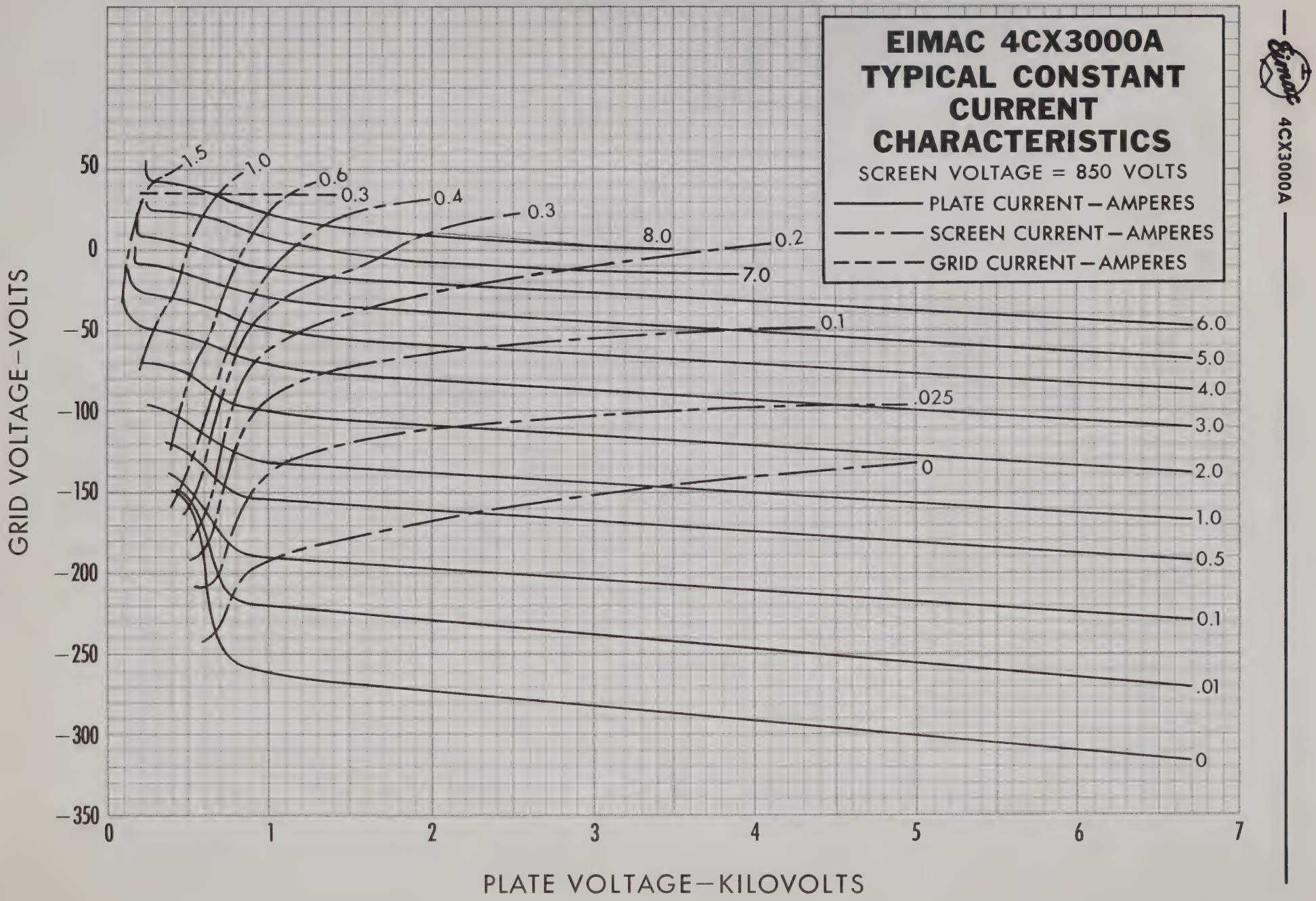


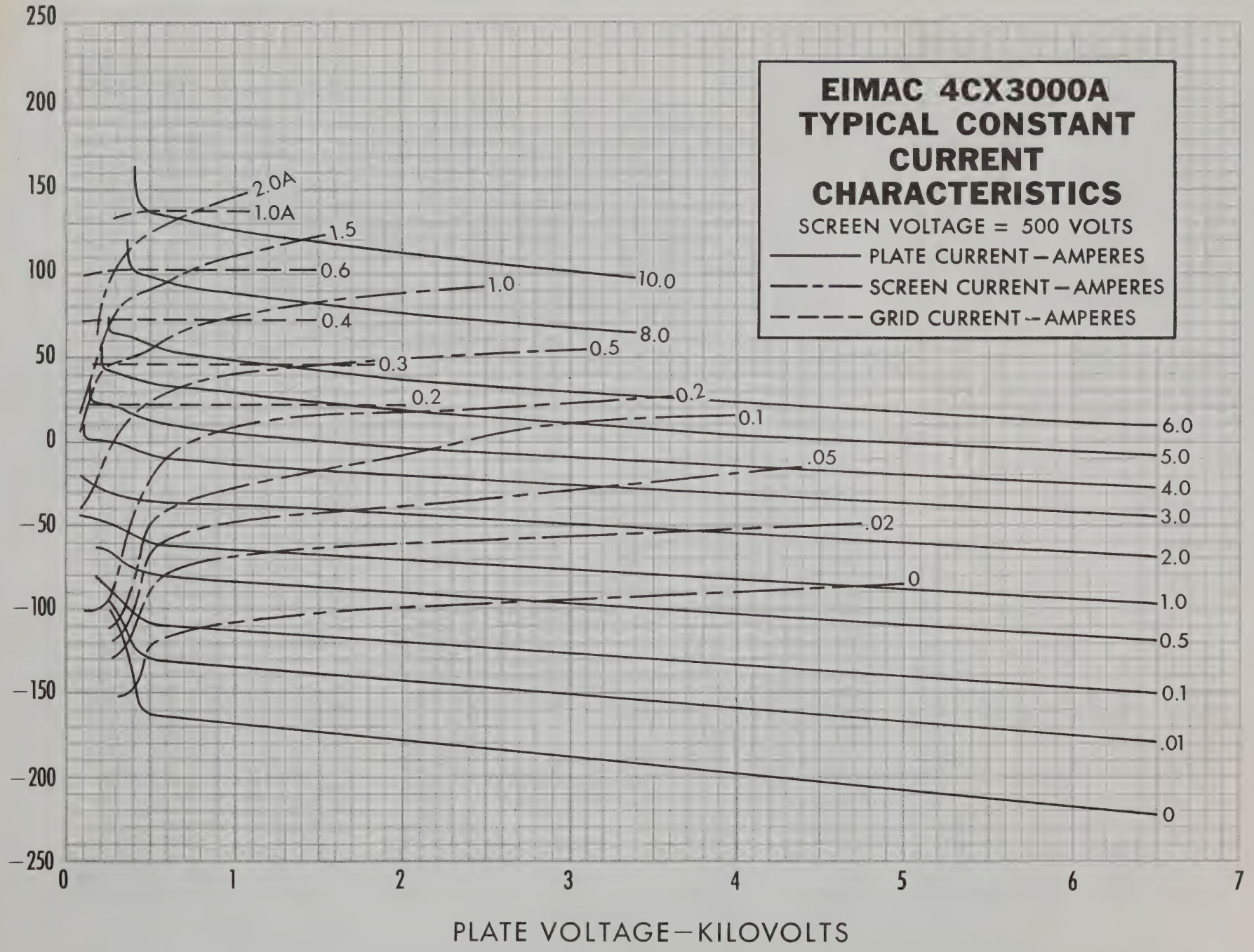
DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN	MAX	NOM.
A	4.585	4.625	
B	.860	.890	
C	2.985	3.025	
D	3.490	3.525	
E	3.050	3.150	
F	5.900	6.100	
G	7.700	7.900	
H	.965	1.005	
J	3.380	3.450	
K	.700	.730	
L	.430	.460	
M	.160	.180	
N	.018	.025	
P	1.050	1.100	
R	39°	41°	
S	89°	91°	
T	.485	.515	
U	1.557	1.567	
V	4.000	4.175	

* CONTACT SURFACE


EIMAC 4CX3000A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 850 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
50
0
–50
–100
–150
–200
–250
–300
–350
PLATE VOLTAGE – KILOVOLTS
0
1
2
3
4
5
6
7
1.5
1.0
0.6
0.3
0.4
0.3
8.0
0.2
7.0
0.1
6.0
5.0
4.0
.025
3.0
0
2.0
1.0
0.5
0.1
.01
0


EIMAC 4CX3000A
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
250
200
150
100
50
0
−50
−100
−150
−200
−250
0
1
2
3
4
5
6
7
2.0A
1.0A
1.5
0.6
1.0
0.4
0.5
0.3
0.2
0.2
0.1
.05
.02
0
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
.01
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8170
4CX5000A

RADIAL-BEAM POWER TETRODE

The EIMAC 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megahertz and is particularly suited for use as a linear single-sideband amplified, Class-AB_1 audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for Class-AB operation.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid Screen)		4.5		
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	pF
Output	18		23	pF
Feedback			1.0	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	48	58	pF
Output	18	23	pF
Feedback		0.16	pF

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250°C
Maximum Anode-Core Temperature	250°C
Recommended Socket	EIMAC SK-300A
Recommended Chimney	EIMAC SK-306
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.13 inches
Diameter	4.94 inches
Cooling	Forced air
Net Weight	9.5 pounds
Shipping Weight (Approximate)	22 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megahertz)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	3 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION
(Frequencies below 30 megahertz)

DC Plate Voltage	7500 volts
DC Screen Voltage	500 volts
DC Grid Voltage	—350 volts
DC Plate Current	2.8 amps
DC Screen Current	0.5 amp
DC Grid Current	0.25 amp
Peak RF Grid Voltage	590 volts
Driving Power	150 watts
Plate Dissipation	5000 watts
Plate Output Power	16,000 watts

(Revised 5-1-67) © 1956, 1961, 1963, 1967 by Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR
(From 30 to 110 megahertz)

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
30 to 60 MHz	7000 VOLTS
60 to 110 MHz	6500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT:	
30 to 60 MHz	2.8 AMPS
60 to 110 MHz	2.6 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Frequencies between 88 and 108 megahertz)

DC Plate Voltage	6500 volts
DC Screen Voltage	750 volts
DC Grid Voltage	—350 volts
DC Plate Current	2.3 amperes
DC Screen Current	0.2 ampere
DC Grid Current	0.05 ampere
Driving Power	100 watts
Useful Output Power	10,000 watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION*	3500 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megahertz)

DC Plate Voltage	5000 volts
DC Screen Voltage	500 volts
Peak AF Screen Voltage (For 100-percent modulation)	450 volts
DC Grid Voltage	—400 volts
DC Plate Current	1.4 amperes
DC Screen Current	0.26 ampere
DC Grid Current	0.05 ampere
Peak RF Grid Voltage	520 volts
Grid Driving Power	25 watts
Plate Dissipation	1100 watts
Plate Output Power	5.8 kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	3.0 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Frequencies below 30 megahertz per tube)

DC Plate Voltage	7500	7500 volts
DC Screen Voltage	350	350 volts
Peak AF Screen Voltage (For 100-percent modulation)	550	550 volts
DC Grid Voltage	—300	—300 volts
DC Plate Current	0.9	1.14 amperes
DC Screen Current*	—0.01	—0.01 ampere
DC Grid Current	0.015	0.03 ampere
Peak RF Grid Voltage	350	375 volts
Grid Driving Power	7	11 watts
RF Load Impedance	2000	1600 ohms
Plate Dissipation	4000	5000 watts
Useful Output Power	2750	3550 watts

*DC Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, two tubes

DC Plate Voltage	4000	5000	6000	7000 volts
DC Screen Voltage	1250	1250	1250	1250 volts
DC Grid Voltage	—270	—280	—310	—325 volts
Max-Signal Plate Current	5.10	4.40	4.25	3.65 amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70 amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24 ampere
Zero-Signal Screen Current	0	0	0	0 amperes
Peak AF Driving Voltage	250	240	270	235 volts
Driving Power	0	0	0	0 watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100 ohms
Max-Signal Plate Dissipation*	4200	4200	4200	4200 watts
Max-Signal Plate Output Power	11,500	13,500	17,000	17,500 watts

*Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, Peak-Envelope or modulation-Crest Conditions, (Frequencies below 30 megahertz)

DC Plate Voltage	7500 volts
DC Screen Voltage	1250 volts
DC Grid Voltage*	—300 volts
Max-Signal Plate Current	1.9 amperes
Zero-Signal Plate Current	0.50 ampere
Max-Signal Screen Current	0.20 ampere
Peak RF Grid Voltage	300 volts
Driving Power	0 watts
Plate Dissipation	4200 watts
Plate Output Power **	10,000 watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or rf output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting — The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

Cooling — The maximum temperature rating for the external surfaces of the 4CX5000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megahertz).

Plate Dissipation* (Watts)	SK-300A Socket		SK-300 Socket	
	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

***Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.**

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation — The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation — The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

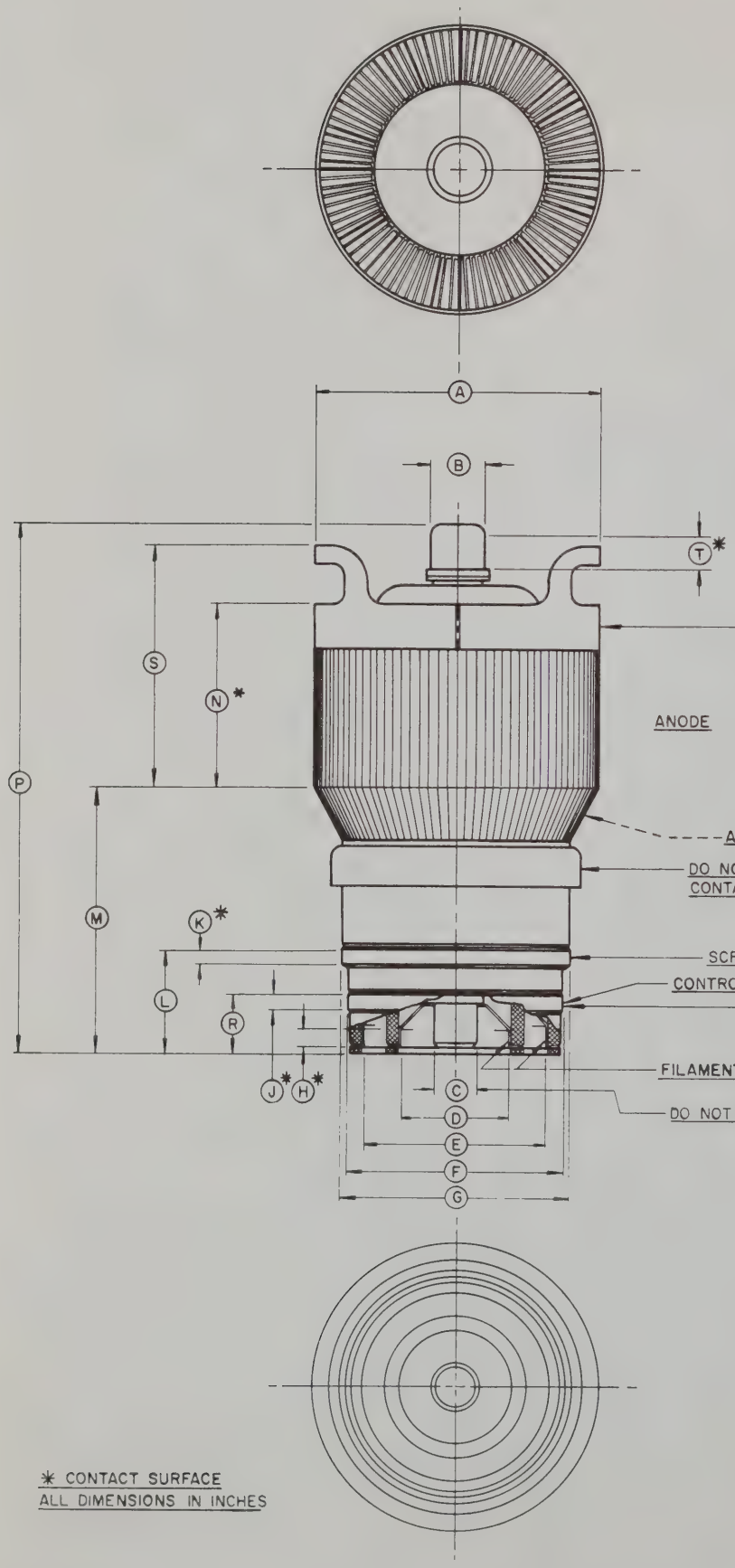
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

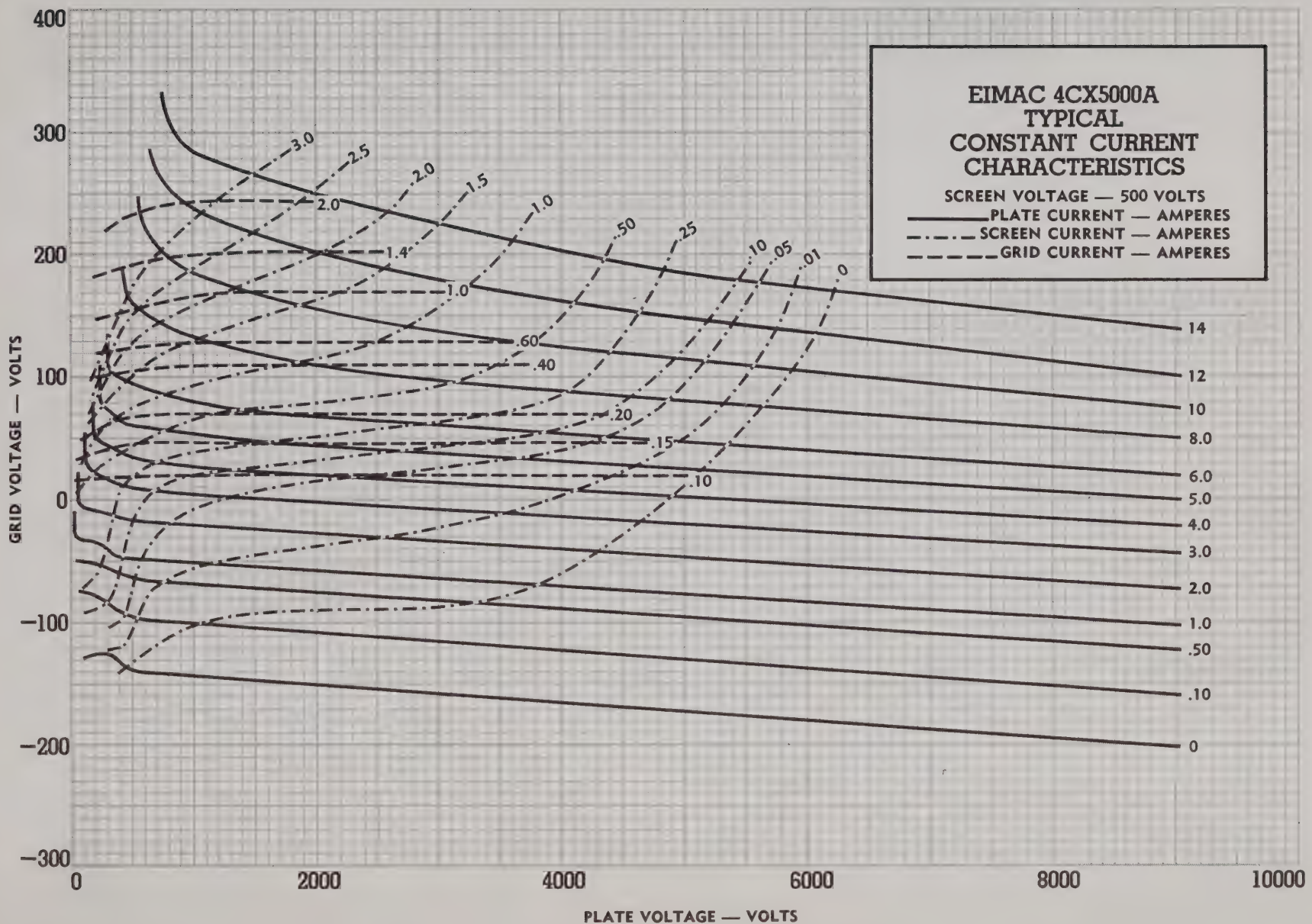
When the 4CX5000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

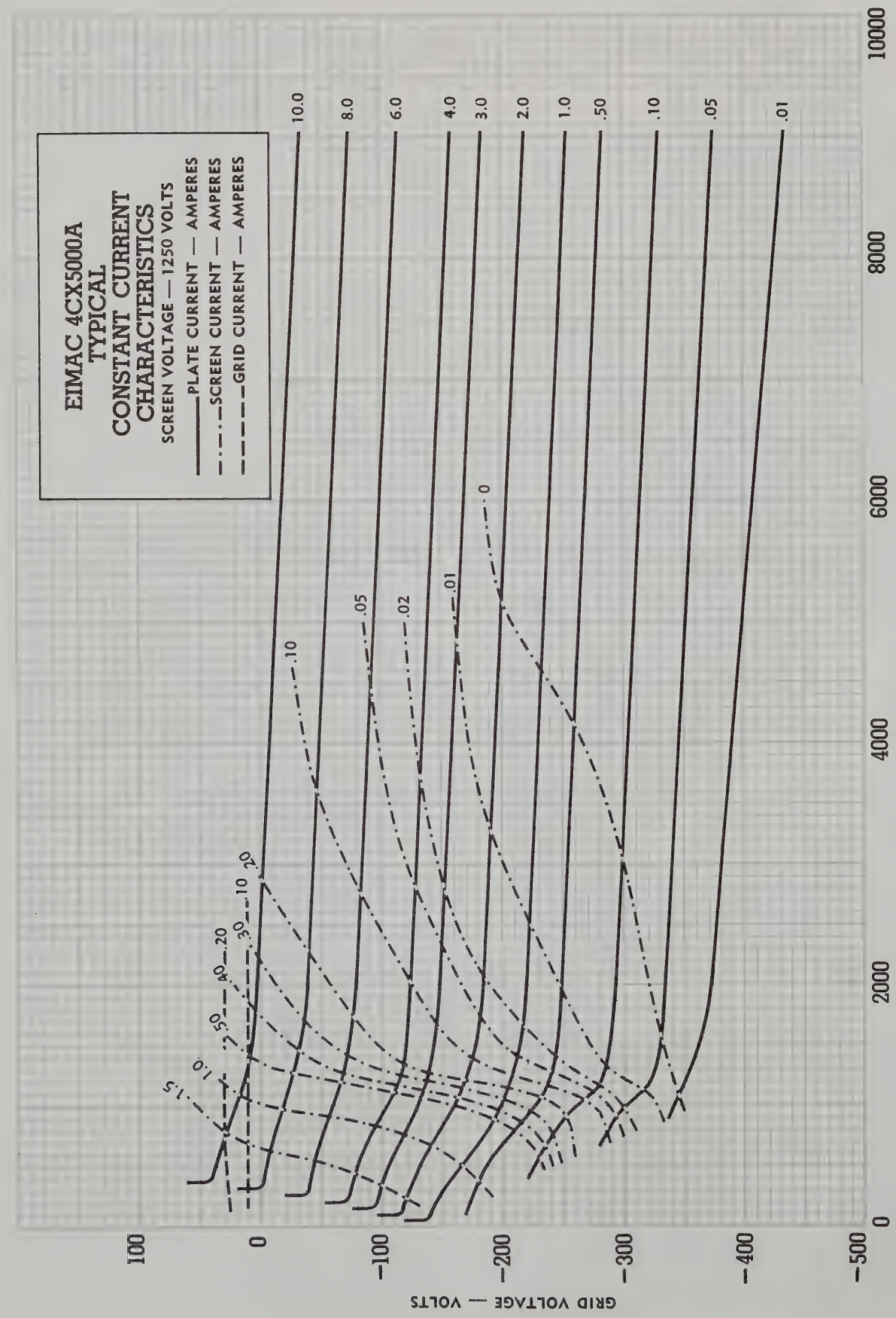
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4.812	4.938
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.188	4.563
N		2.875	3.250
P		8.625	9.125
R		.986	1.050
S		3.875	4.250
T		.375	

* CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
3.0
2.5
2.0
1.5
1.0
.50
.25
.10
.05
.01
0
2.0
1.4
1.0
.60
.40
.20
.15
.10
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.50
.10
.05
.01
0
.01
.02
.05
.10
1.5
1.0
.50
.40
.30
.20
.10
.20
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian

5CX1500A
RADIAL BEAM POWER PENTODE

The EIMAC 5CX1500A is a ceramic and metal power pentode designed to be used as a Class-AB$_1$ linear amplifier in audio or radio-frequency applications. Its characteristic low intermodulation distortion makes it especially suitable for single sideband service. The filament is a rugged mesh type.

The tube is also recommended for use as a Class-C radio-frequency power amplifier, and plate-modulated radio-frequency power amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten Mesh				
Voltage		5.0		volts
Current	38		43	amps
Amplification Factor (Grid Screen)		5.5		
Transconductance (at Ib=1.0 amp, Ec_2=500 volts, Eb=2000 volts)		24,000		μmhos
Frequency For Maximum Ratings			110	MHz
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	68		78	pF
Output	14.5		18.5	pF
Feedback			.25	pF

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	EIMAC SK-840 series
Recommended Air Chimney	EIMAC SK-806
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	5.0 inches
Diameter	3.4 inches
Cooling	Forced Air
Net Weight	30 ounces
Shipping Weight (Approximate)	3 pounds

(Revised 4-15-67) © 1965, 1967 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	1.0 AMPS
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	75 WATTS
GRID DISSIPATON	25 WATTS
SUPPRESSOR DISSIPATION	25 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000	4000	4500 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—200	—200	—200 volts
DC Suppressor Voltage	0	0	0 volts
DC Plate Current	900	800	900 mA
DC Screen Current	94	66	88 mA
DC Grid Current	35	25	34 mA
Peak RF Grid Voltage	255	245	255 volts
Driving Power	9	6.5	9 watts
Plate Output Power	1980	2350	3180 watts
Plate Dissipation	720	850	870 watts
Resonant Load Impedance	1570	2240	2520 ohms

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3500 VOLTS
DC SCREEN VOLTAGE	550 VOLTS
DC PLATE CURRENT	0.8 AMPS
PLATE DISSIPATION*	1000 WATTS
SCREEN DISSIPATION	75 WATTS
GRID DISSIPATON	25 WATTS
SUPPRESSOR DISSIPATION	25 WATTS

*Corresponds to 1500 watts at 100% sine-wave modulation

TYPICAL OPERATION

DC Plate Voltage	2500	3200 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	—260	—260 volts
DC Suppressor Voltage	0	0 volts
Peak AF Screen Voltage (For 100% Modulation)	500	500 volts
DC Plate Current	800	800 mA
DC Screen Current	90	86 mA
DC Grid Current	32	32 mA
Peak RF Grid Voltage	315	315 volts
Grid Driving Power	10	10 watts
Plate Dissipation	530	576 watts
Plate Outut Power	1470	1958 watts
Resonant Load Impedance	1360	1863 ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	1.0 AMPS
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	75 WATTS
GRID DISSIPATON	25 WATTS
SUPPRESSOR DISSIPATION	25 WATTS

*Adjust for Zero-Signal Plate Current
**Per tube

TYPICAL OPERATION (Two Tubes), Class AB_1

DC Plate Voltage	2800	3800 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage*	—81	—83 volts
DC Suppressor Voltage	0	0 volts
Max-Signal Plate Current	1.30	1.33 amps
Zero-Signal Plate Current	0.50	0.50 amps
Max-Signal Screen Current	110	106 mA
Zero-Signal Screen Current	20	20 mA
Peak AF Driving Voltage	81	83 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	4800	6720 ohms
Max-Signal Plate Dissipation**	720	1130 watts
Max-Signal Plate Output Power	2200	3220 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	1.0 AMPS
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	75 WATTS
GRID DISSIPATON	25 WATTS
SUPPRESSOR DISSIPATION	25 WATTS

*Adjust to the specified Zero-Signal Plate Current
**The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies Below 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions
Crest Conditions

DC Plate Voltage	2500	3000	4000 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage*	—87	—89	—90 volts
DC Suppressor Voltage	0	0	0 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current	660	690	690 mA
Two-Tone DC Plate Current	468	482	485 mA
Single-Tone DC Screen Current	79	71	59 mA
Two-Tone DC Screen Current	36	32	25 mA
Peak RF Grid Voltage	87	89	90 volts
Driving Power	0	0	0 watts
Useful Output Power	1090	1330	1785 watts
Resonant Load Impedance	2340	2680	3500 ohms
Intermodulation Distortion Products**			
3rd Order	—38	—36	—33 db
5th Order	—39	—41	—42 db

APPLICATION

MECHANICAL

Mounting

The 5CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket

The EIMAC SK-840 socket and SK-806 chimney have been designed especially for the 5CX-1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and through the anode cooling fins.

Cooling

The maximum temperature rating for the anode core of the 5CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

	SEA LEVEL		6000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	27	.33	33	.40
1500	47	.76	58	.95

*Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen-plus-suppressor dissipation can, under some conditions, represent another 125 watts, allowance has been made in preparing this tabulation for an additional 325 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation

The rated filament voltage for the 5CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value or below to obtain maximum tube life.

Intermodulation Distortion

The Radio Frequency Linear Amplifier operating conditions including distorton data are the results of actual operation in a neutralized, grid-driven amplifier. Plots of IM distortion versus power output under two-tone condition for a typical tube are shown on the next page.

Control Grid Operation

The rated dissipation of the grid is 25 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

Screen Grid Operation

The power dissipated by the screen of the 5CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon RMS screen current and voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

Suppressor Grid

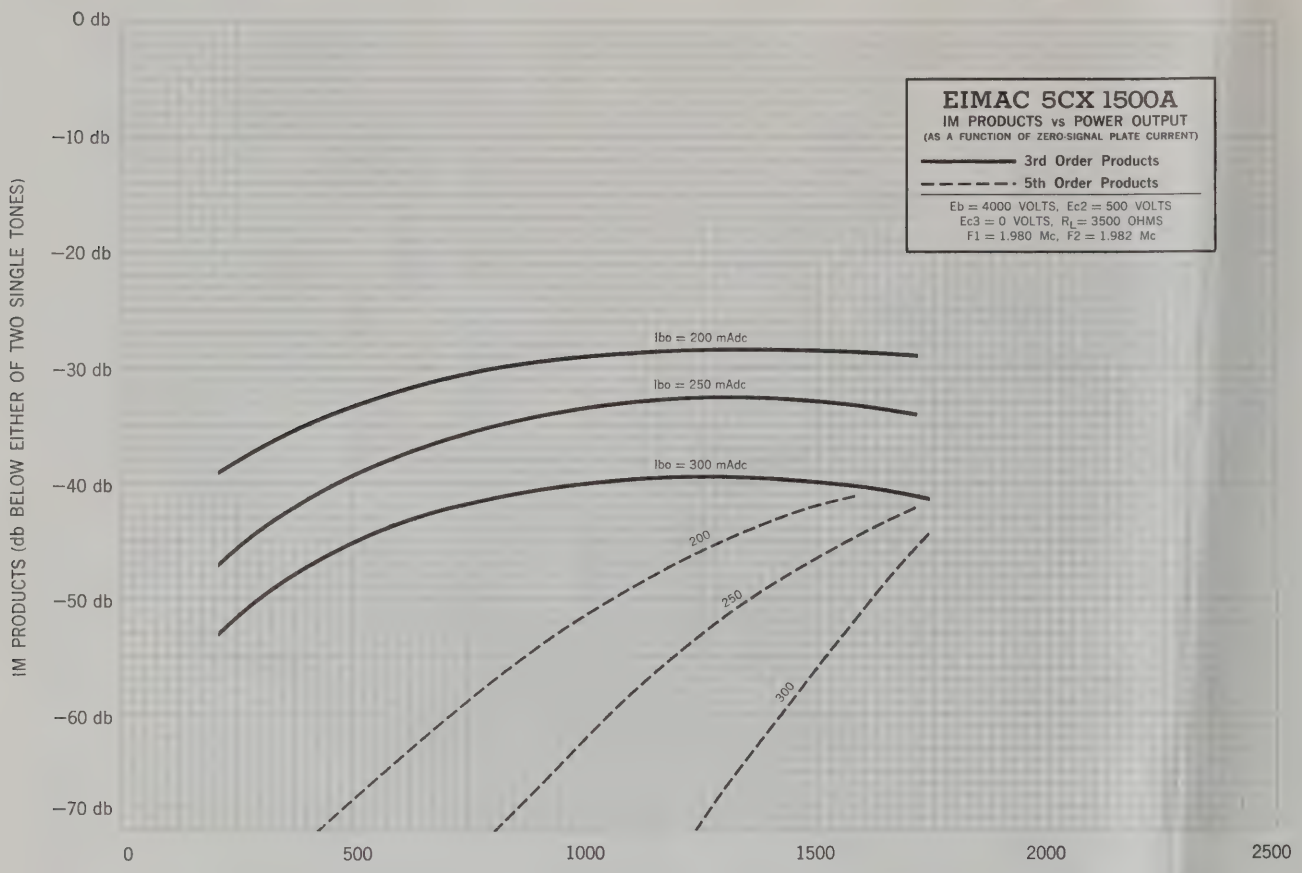
The rated dissipation of the suppressor grid is 25 watts. Suppressor current will be zero or very nearly zero for all typical operating conditions specified. The 5CX1500A has been designed for zero voltage operation of the suppressor grid for most applications.

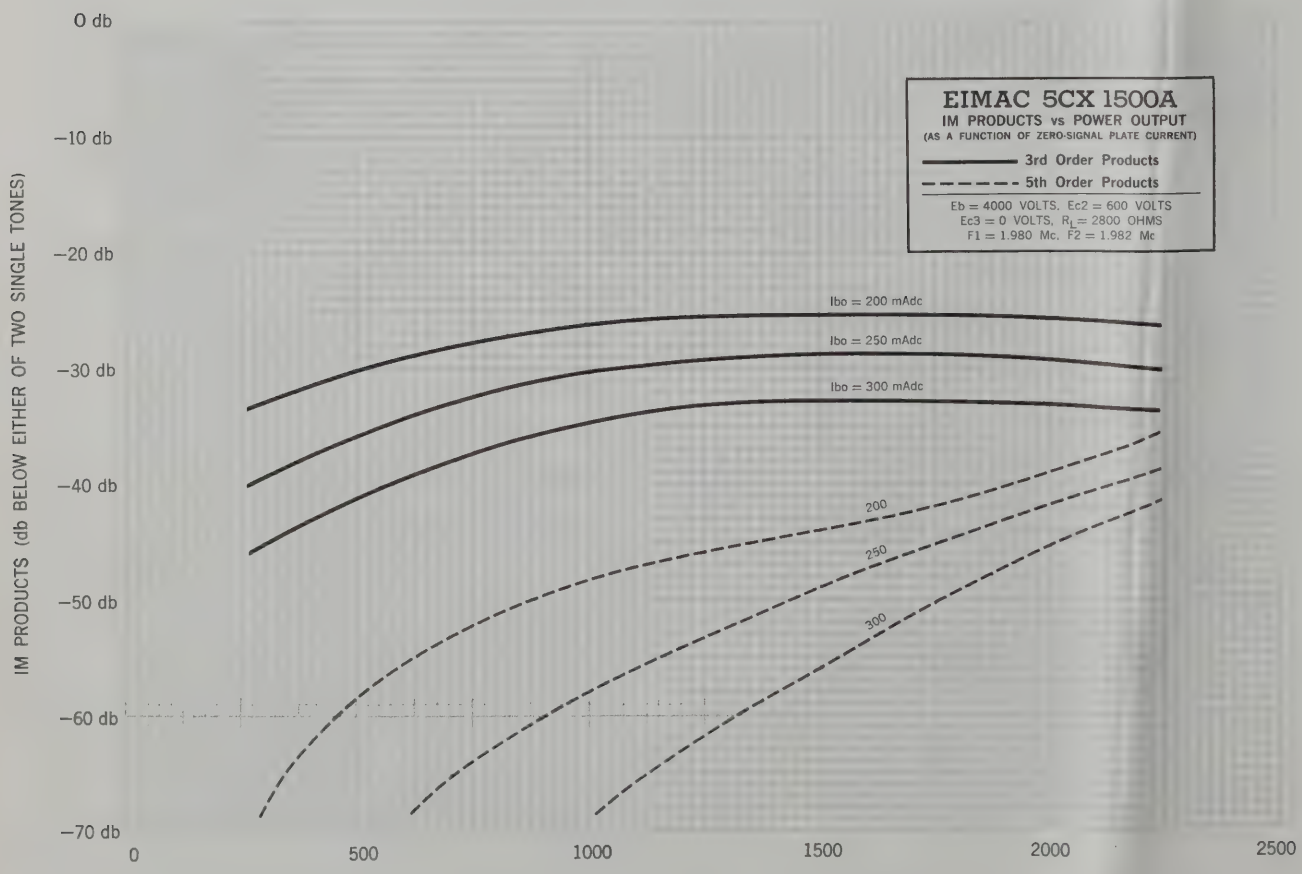
Plate Dissipation

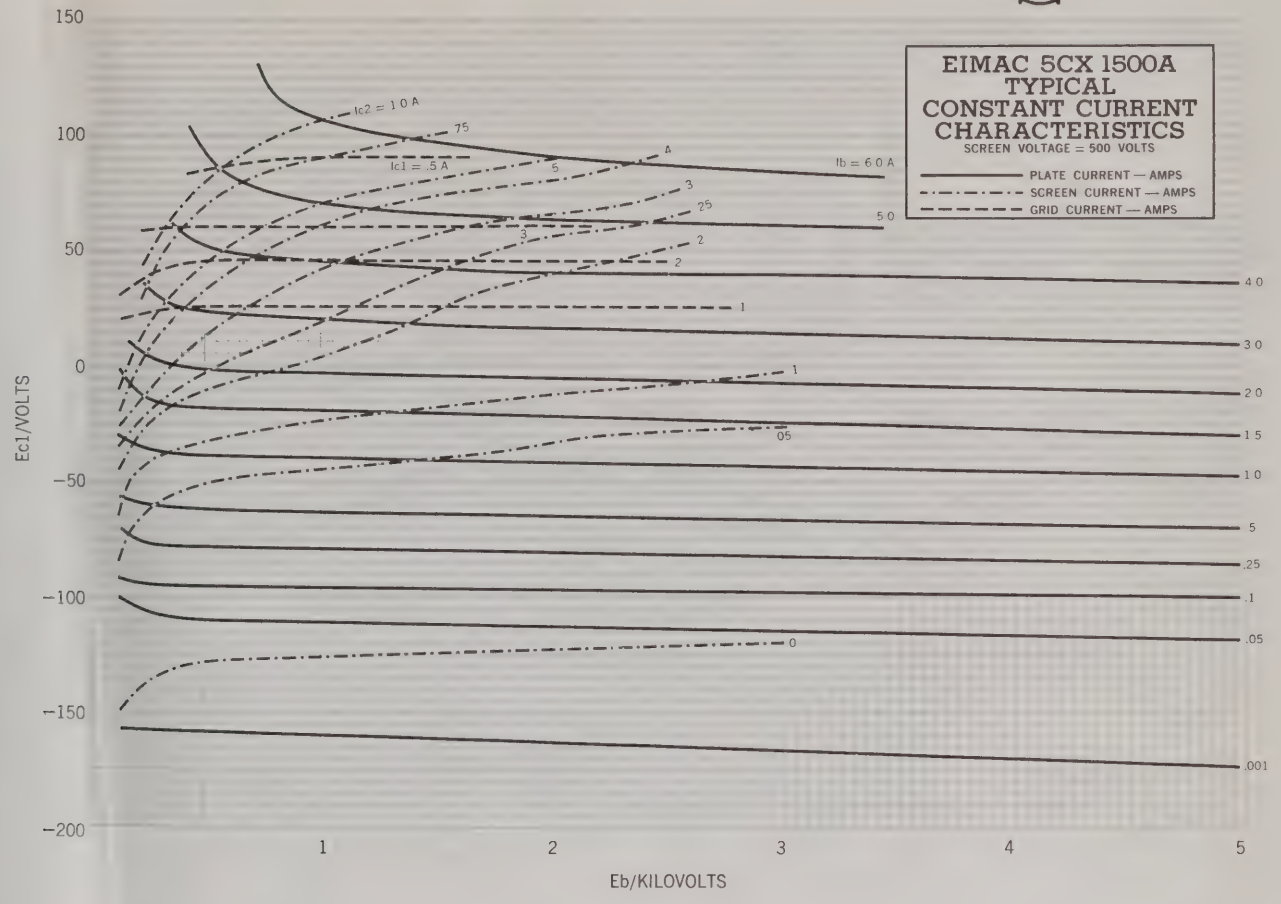
The plate-dissipation ratings for the 5CX-1500A is 1000 watts for Class-C plate-modulated service and 1500 watts for Class-C telegraphy. In Class-AB service the plate dissipation rating is 1500 watts.

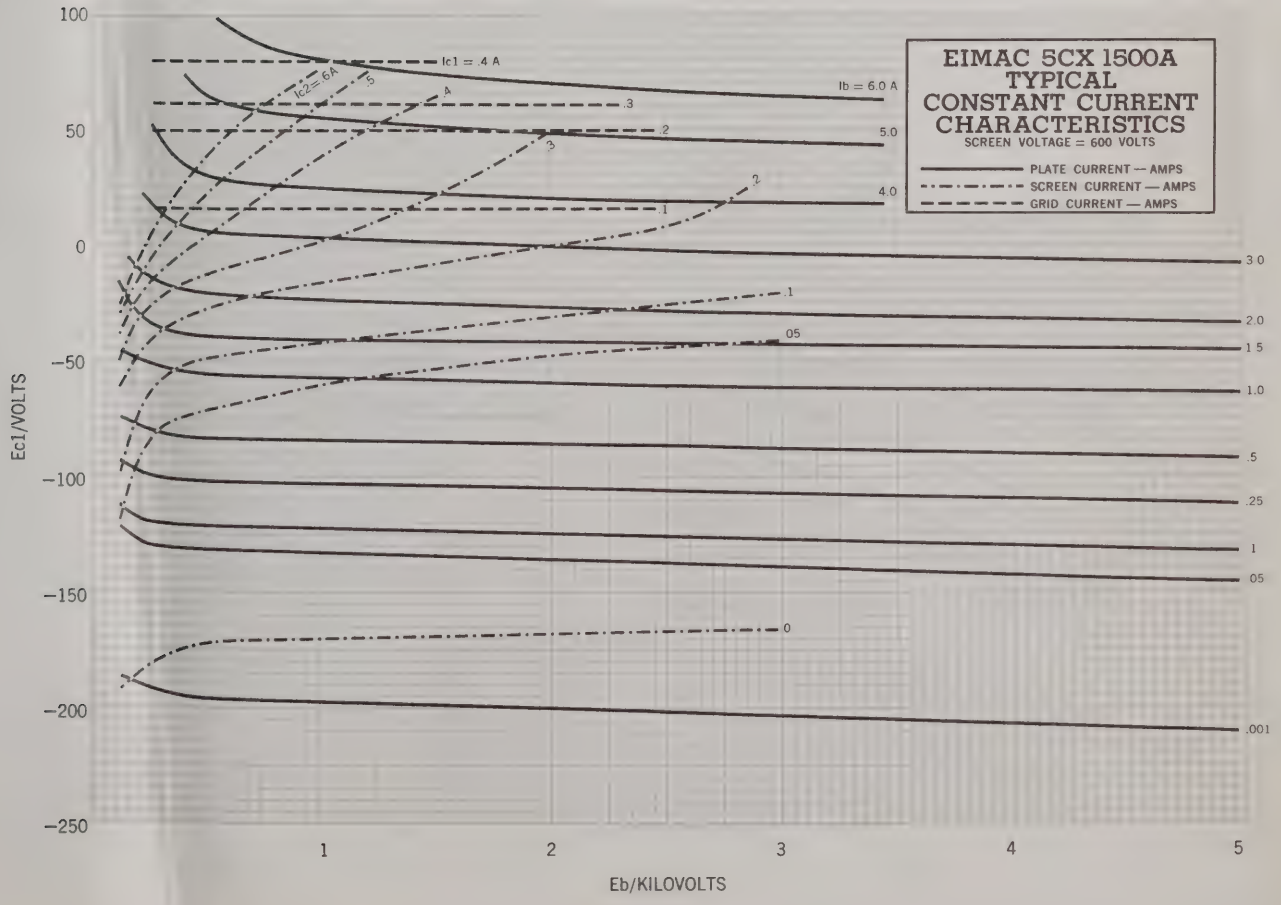
Special Applications

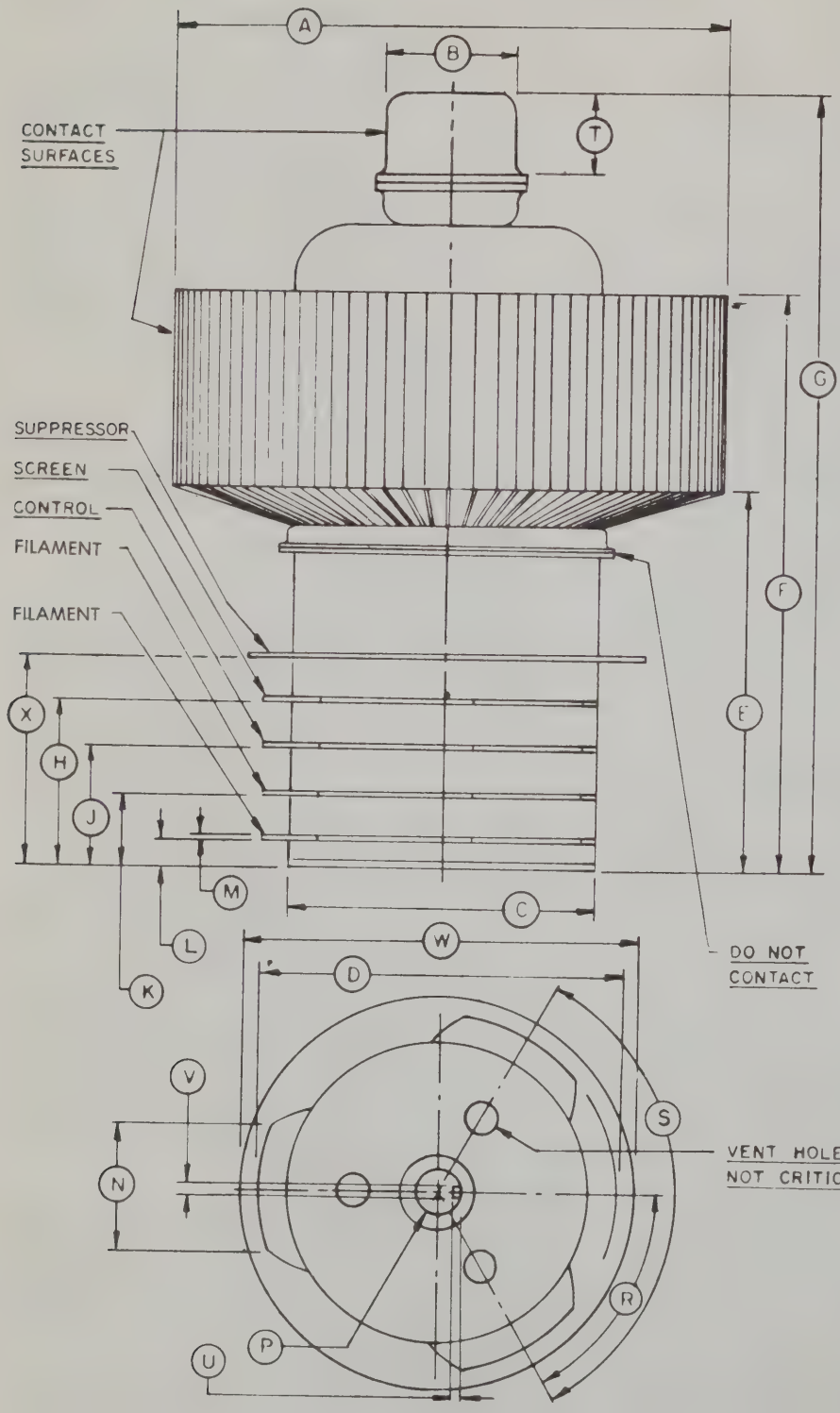
If it is desired to operate this tube under conditions widely different from those given here write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 500 VOLTS
Ec3 = 0 VOLTS, RL = 3500 OHMS
F1 = 1.980 Mc, F2 = 1.982 Mc
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
Ibo = 200 mAdc
Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0
500
1000
1500
2000
2500


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 600 VOLTS
Ec3 = 0 VOLTS, RL = 2800 OHMS
F1 = 1.980 Mc, F2 = 1.982 Mc
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
Ibo = 200 mAdc
Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0
500
1000
1500
2000
2500


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ec1/VOLTS
Eb/KILOVOLTS
Ic2 = 1.0 A
Ic1 = .5 A
Ib = 6.0 A
5.0
4.0
3.0
2.0
1.5
1.0
.5
.25
.1
.05
.001
0
150
100
50
0
−50
−100
−150
−200
1
2
3
4
5


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 600 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ec1/VOLTS
Eb/KILOVOLTS
Ic1 = .4 A
Ic2 = 6A
Ib = 6.0 A
5.0
4.0
3.0
2.0
1.5
1.0
.5
.25
1
.05
.001
0
100
50
0
−50
−100
−150
−200
−250
1
2
3
4
5



DIMENSIONAL DATA			
DIM	MIN	MAX	REF.
A	3.335	3.370	
B	.807	.820	
C	1.870	1.900	
D	2.250 DIA	2.300 DIA	
E	2.335	2.535	
F	3.530	3.730	
G	4.800	4.950	
H	.950	1.000	
J	.675	.725	
K	400	.450	
L	.140	170	
M	.020	.030	
N	.700	.800	
P	.314 DIA	.326 DIA	
R	55°	65°	
S	115°	125°	
T	.470	.530	
U	.025	.048	
V	.045 DIA	.070 DIA	
W	2.468	2.531	
X	1.225	1.275	

NOTE:
REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

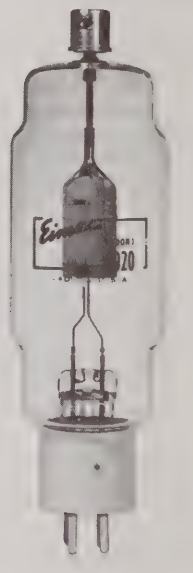
8020

HIGH-VACUUM RECTIFIER

The EIMAC 8020 diode is a high-vacuum rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 8020 has a maximum dc current rating of 100 milliamperes and a maximum peak inverse voltage rating of 40,000 volts. Cooling is by convection and radiation.

A single 8020 will deliver 80 milliamperes at 17,000 volts to a capacitor-input filter with 14,000 volts single-phase supply. Four 8020's in a bridge circuit will deliver 200 milliamperes at 25,000 volts to a choke-input filter with 28,000 volts single-phase supply.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	6.5	amperes

MECHANICAL

Base	Medium 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	EIMAC HR-8
Maximum Overall Dimensions:	
Length	8.00 inches
Diameter	2.32 inches
Net Weight	4 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per Tube)

Peak Inverse Plate Voltage	40,000	volts
Plate Dissipation	60	watts
DC Plate Current[1]	100	ma
Peak Plate Current	1.5	ampere

[1] Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum dc current ratings under this and other load conditions see discussion under "Application."

APPLICATION

MECHANICAL

Mounting—The 8020 must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The medium 4-pin bayonet base fits an E. F. Johnson Co. No. 122-124, a National Co. No. XC-4 or CIR-4, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 8020 is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for free circulation of air. An EIMAC HR-8 Heat Dissipating Connector or equivalent is required on the plate terminal.

(Revised 6-1-67) © 1952, 1967 Varian

Printed in U.S.A.

APPLICATION (Continued)

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq," a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

Caution should be observed when measuring rectifier filament voltage. The filament circuit may be at high potential.

The thoriated-tungsten filament of the 8020 reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 8020 begins to show color as the maximum plate dissipation rating of 60 watts is approached. The maximum peak inverse voltage rating of 40,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 8020 when used as a power-supply rectifier.

8020 MAXIMUM PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	AC Input Voltage (volts rms)	DC Output Voltage (volts)	DC Output Current (ma)	DC Output Voltage (volts)	DC Output Current (ma)
Single-Phase, Half-Wave	14,000	17,000	80	.....	...
Single-Phase, Full-Wave	14,000[1]	17,000	160	12,500	200
Single-Phase, Bridge	28,000	34,000	160	25,000	200

[1] One-half the transformer secondary voltage.

Maximum DC Current Ratings—Plate dissipation rather than peak current usually limits the dc current which the 8020 is capable of delivering to the load. Because the plate dissipation associated with a given dc current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum dc current rating of the tube.

Choke-Input Filter—The maximum dc current rating of the 8020 is 100 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),

f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 8020 is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum dc current rating of the 8020 when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input dc voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the dc current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the dc current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube $\left(\frac{E_c}{I_p}\right)$. The total charging circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the ac voltage supply, R_i.

R_p is the plate resistance of the 8020, which may be taken as 1000 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 8020 is 40,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak ac supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- or full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a large percent ripple is tolerable and filter capacitance is low, the 8020 is capable of larger dc output currents.

As a unidirectional conductor in dc circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 8020 is 200 milliamperes.

The plate characteristic curve for the 8020 serves as a guide to special applications. The maximum plate dissipation rating of 60 watts, the maximum peak inverse voltage rating of 40,000 volts, and the maximum peak plate current of 1.5 amperes must not be exceeded.

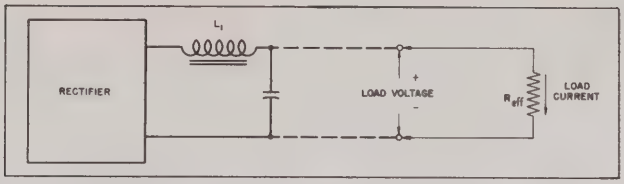
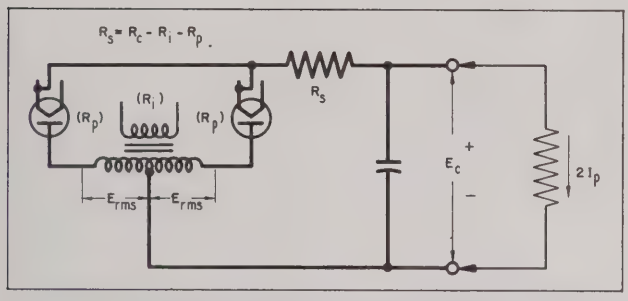
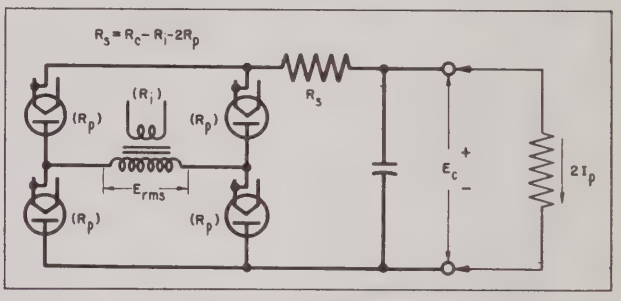


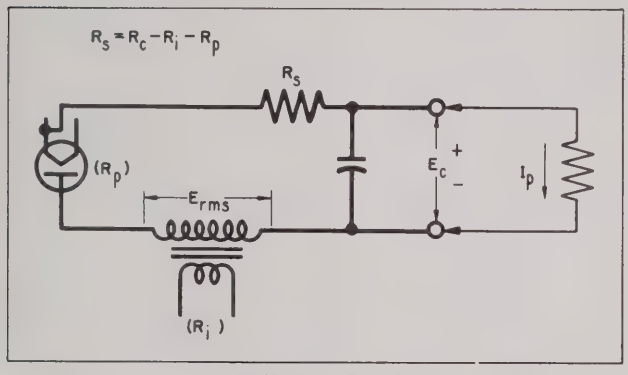
Fig. 1. Rectifier with Choke-Input Filter



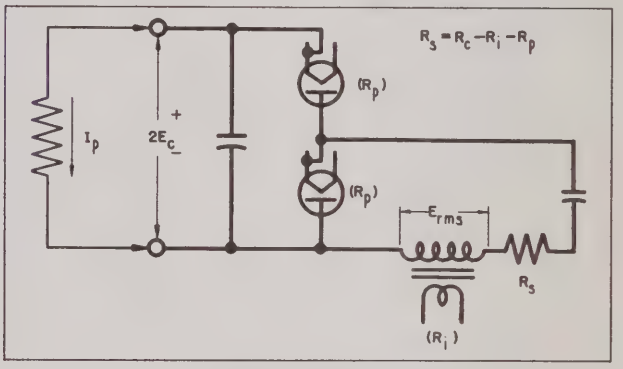
a. Full-Wave Center-Tapped Rectifier



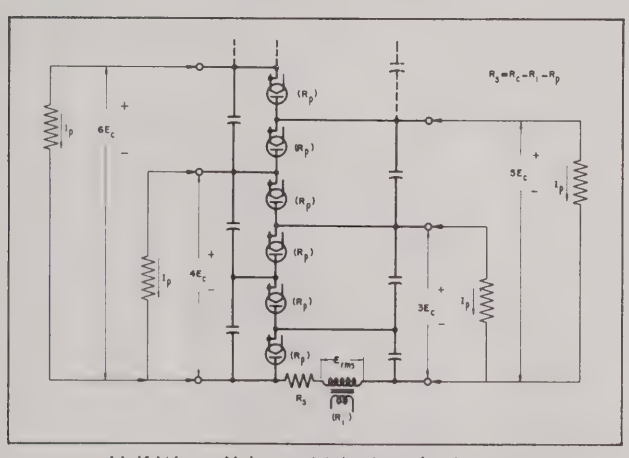
b. Full-Wave Bridge Rectifier



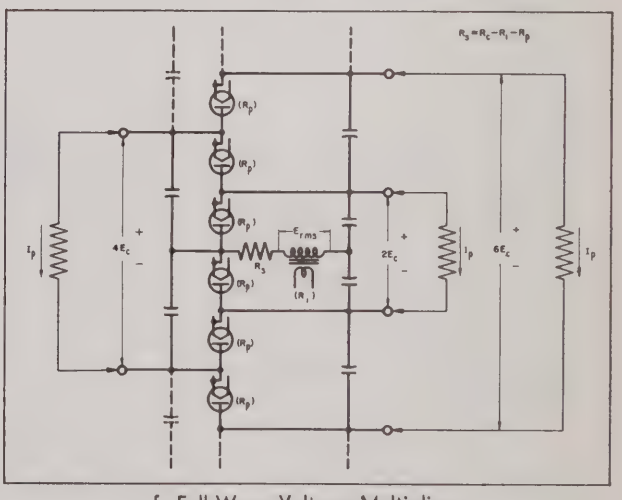
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



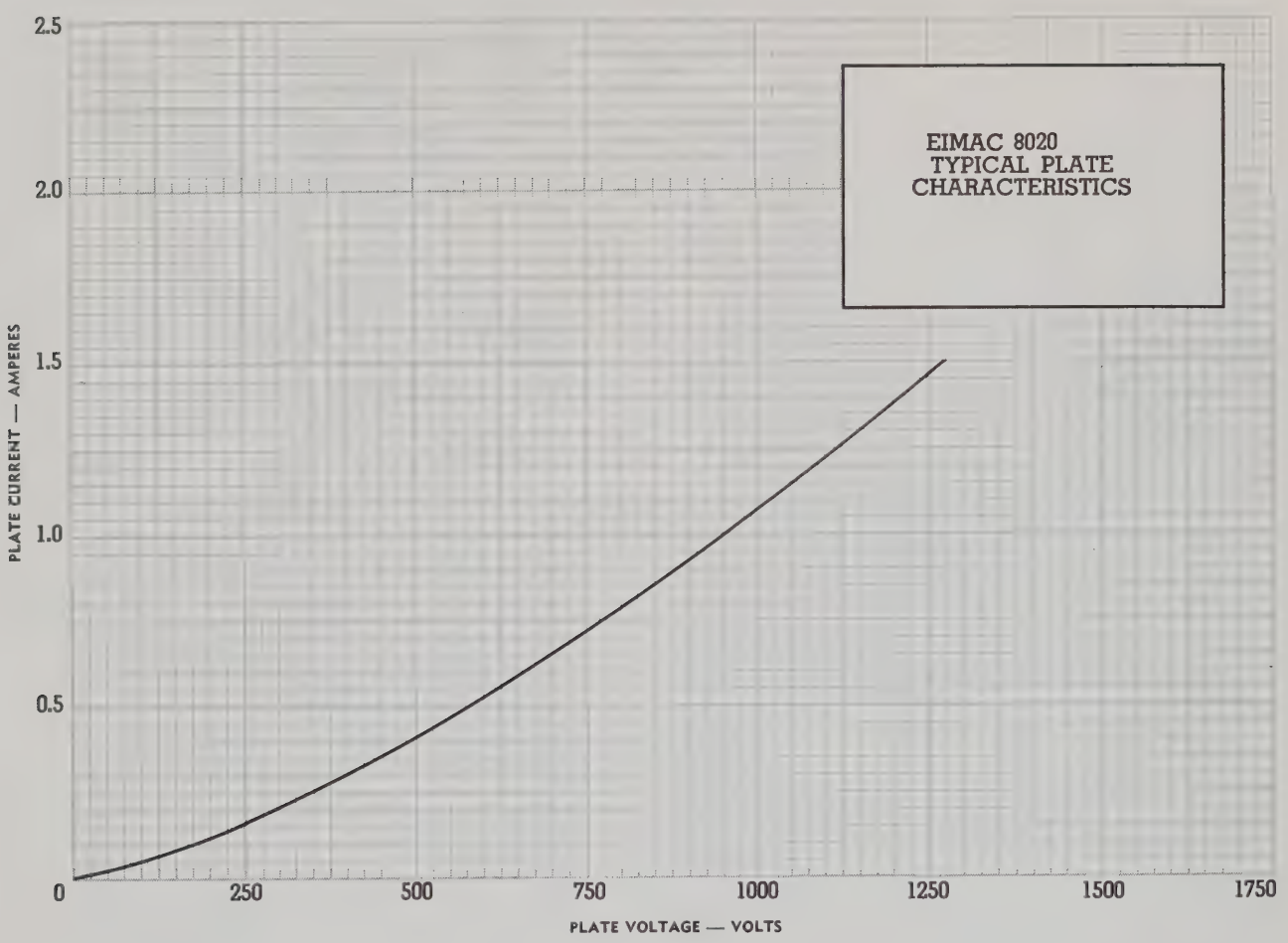
e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})

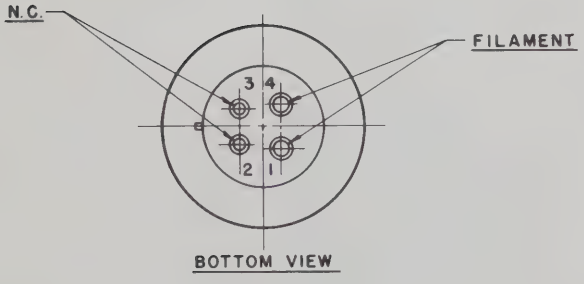


f. Full-Wave Voltage Multiplier

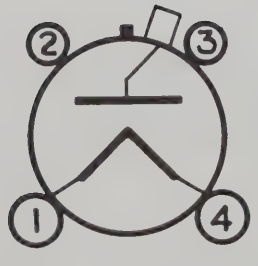
Eimac 8020 Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	70	75	80	85	90	95	100	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	0.8	1.2	1.8	3.0	4.7	7.6	12	percent of Effective Load Resistance per Tube $\left(\frac{E_c}{I_p}\right)$
A-C Supply Voltage (E_{rms})	0.78	0.80	0.83	0.87	0.92	1.01	1.14	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values in circuit "b".)	2.2	2.3	2.4	2.5	2.6	2.9	3.2	times Filter-Input D-C Voltage (E_c)

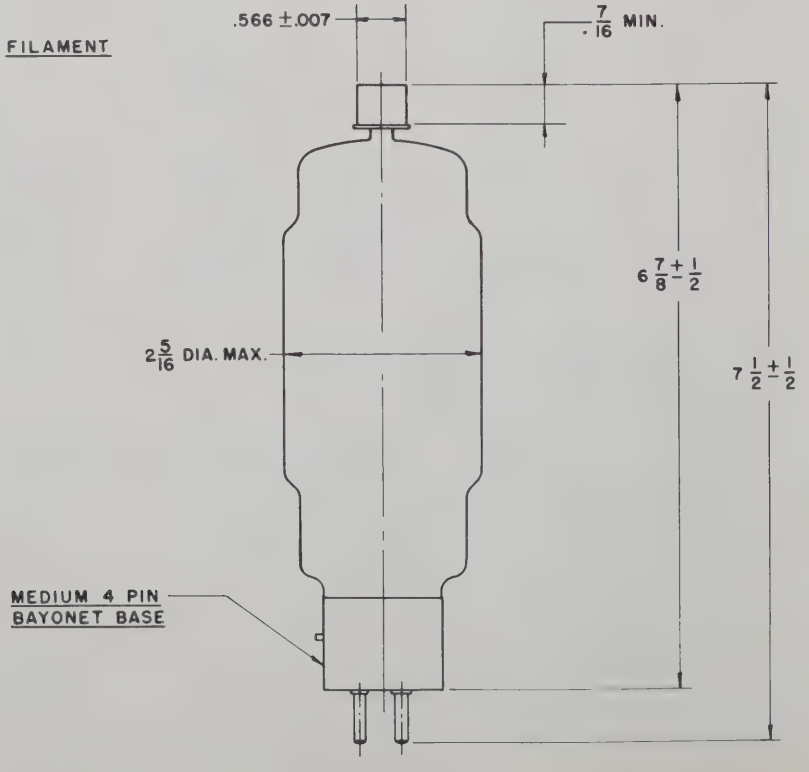
Fig. 2. EIMAC 8020 Basic R-C Circuits (for any one of the indicated loads)
R_1 = Equivalent resistance of voltage source
R_p = 1000 ohms (500 ohms for two tubes in parallel)





BOTTOM VIEW





DIMENSIONS
IN INCHES

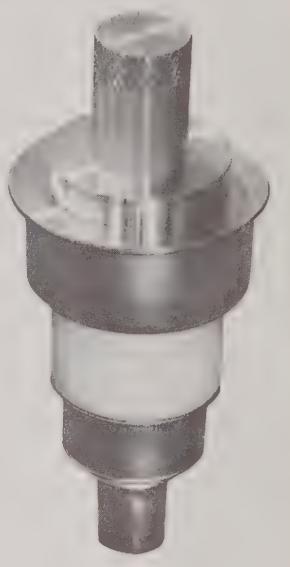
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

7815
3CPN10A5

UHF
PULSE
TRIODE

The EIMAC 7815/3CPN10A5 is a low duty pulse rated version of the 3CX100A5 with the anode cooler removed. A longer grid-anode ceramic insulator is incorporated, making the tube useful at high altitude. The nominal plate dissipation rating is 10 watts but may be increased if sufficient cooling is provided. Cooling is accomplished by conduction through a suitable heat sink or convection. Where greater plate dissipation is required, the 7815R/3CPX100A5 should be used.

The tube is usable in pulse applications to 3000 MHz. Electrical characteristics except for plate dissipation are similar to the 3CX100A5.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-coated, Unipotential				
Heating time	60			seconds
Heater:				
Voltage		6.0		volts
Current	0.90		1.05	amperes
Amplification Factor		100		
Transconductance (1 b = 70 milliamperes)		25,000		Micromhos

Direct Interelectrode Capacitances	Min.	Max.	
Grid-Cathode	5.6	7.0	pF
Grid-Plate	1.86	2.10	pF
Plate-Cathode		0.035	pF
Frequency for Maximum Ratings		3000	MHz

MECHANICAL

Terminals	Graduated Cylindrical Surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Cooling	Conduction and Convection
Maximum Overall Dimensions:	
Length	2.701 inches
Diameter	1.195 inches
Net Weight	2.0 ounces
Shipping Weight (approx.)	7.0 ounces

PLATE PULSED OSCILLATOR OR AMPLIFIER CLASS-C

MAXIMUM RATINGS

Peak Pulse Plate Voltage	3500 volts
DC Grid Voltage	−150 volts
Pulse Plate Current	3.0 amps
DC Cathode Current	125 ma
Pulse Grid Current	1.8 amps
Plate Dissipation (average)	10 watts
Grid Dissipation (average)	2 watts

TYPICAL OPERATION

Pulse Plate Voltage	3500	3500 volts
Pulse Plate Current	3.0	3.0 amps
DC Plate Current (average)	7.5	9 ma
DC Grid Current (average)	4.5	3 ma
Pulse Power Output	1600	2000 watts
Frequency	3000	2500 MHz
Pulse Length	3	5 usec
Duty Factor	0.0025	0.003

(Revised 4-15-67) © 1963, 1967 by Varian

Printed in U.S.A.

GRID PULSED OSCILLATOR OR AMPLIFIER
CLASS-C

MAXIMUM RATINGS

DC Plate Voltage	2000 volts
DC Grid Voltage	—150 volts
Pulse Plate Current	3.0 amps
DC Cathode Current	125 ma
Plate Dissipation (average)	10 watts
Grid Dissipation (average)	2 watts

TYPICAL OPERATION

DC Plate Voltage	1600	1700 volts
DC Grid Voltage	—45	—45 volts
Pulse Plate Current	3.0	1.9 amps
Pulse Grid Current	1.8	1.1 amps
Pulse Power Output	1000	1500 watts
Frequency	3000	1100 MHz
Pulse Length	3	3.5 usec
Duty Factor	0.0025	0.001

APPLICATION

MECHANICAL

Mounting—The 3CPN10A5 may be operated in any position. It should be firmly held in place by spring-finger collets bearing on the terminal surfaces. In use the tube should seat against the underside of the anode-terminal flange which is on the plane of reference for longitudinal dimensions. In applications involving severe shock and vibration, the tube may be clamped in place by applying a suitable clamping device to the anode-terminal flange. It is recommended that no other portion of the tube be subjected to clamping forces.

Connections—The terminals are in the form of concentric cylinders of graduated diameters conveniently used with coaxial tuning devices. Spring-fingered collets should be used to make contact with the anode, grid, cathode and heater terminals. Adequate contact area and spring pressure should be provided to minimize heating and to prevent erratic circuit performance at the higher frequencies. Non-contacting or intermittently-contacting collet fingers will cause troublesome circuit behavior, especially at very-high and ultra-high frequencies. Electrode contact surfaces should be kept clean and free of oxide coatings.

Cooling—Sufficient cooling air must be provided for the anode and body seals to maintain operating temperatures below the rated maximum value of 250°C.

The nominal plate dissipation rating is 10 watts and is dependent on convection cooling to a heat sink. Where adequate cooling is provided this value may be extended. Where greater plate dissipation is required use of the 3CPX100A5 is recommended.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness, regardless of the coolant type, flow rate or coolant temperature. One method of measuring the surface temperature is the use of temperature sensitive lacquer, such as "Tempilaq."

ELECTRICAL

Heater Operation—The rated heater voltage for the 3CPN10A5 is 6.0 volts. The heater voltage for the 3CPN10A5 should be maintained within plus or minus 5% of its intended value to minimize variations in circuit performance and to obtain maximum tube life.

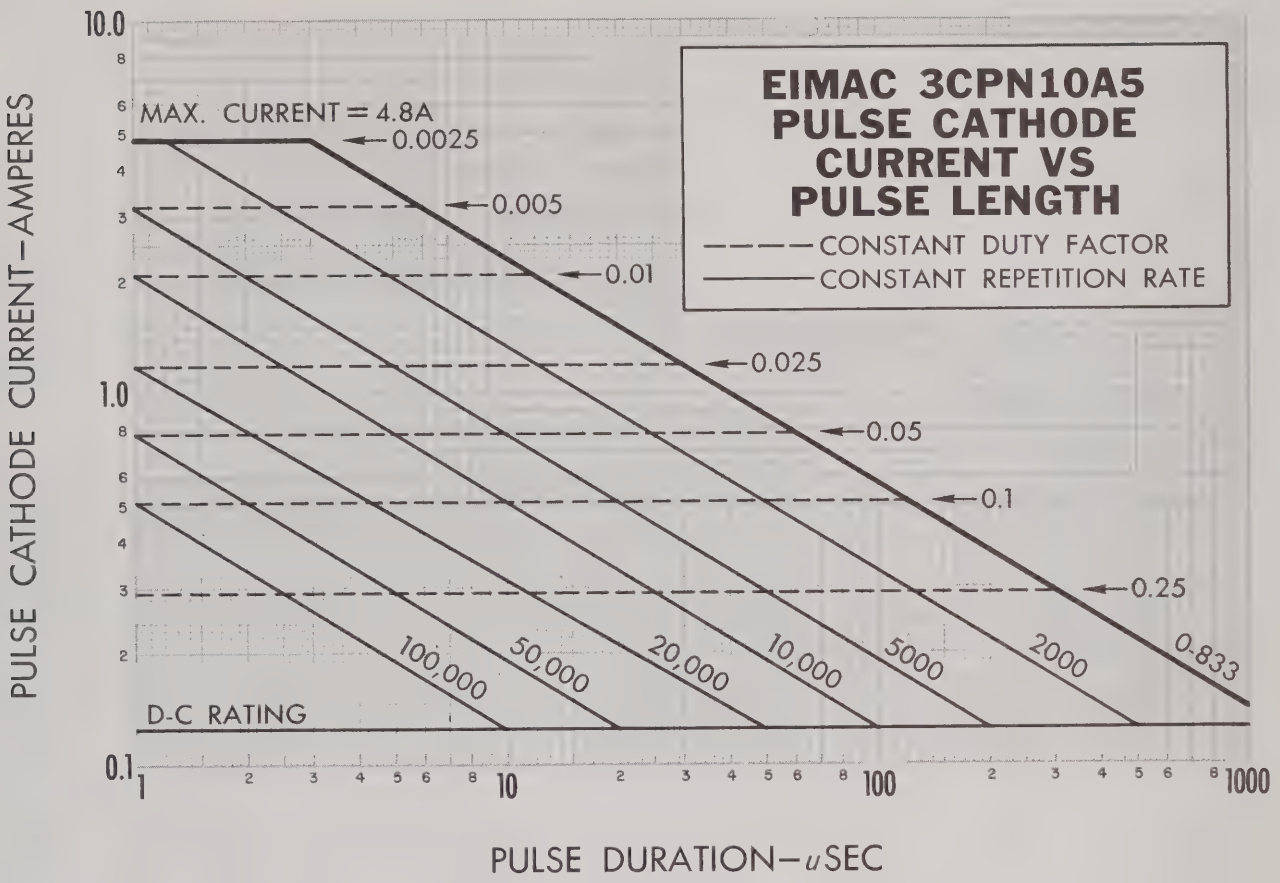
At frequencies above approximately 1000 MHz, transit time effects begin to influence cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, driving power, and duty factor. If the conditions of operation result in appreciable cathode back-heating, it may be necessary to start dynamic tube operation at normal heater voltage followed by a reduction of heater voltage to a lower value. The heater of the 3CPN10A5 must not be operated at less than 4.5 volts in any case.

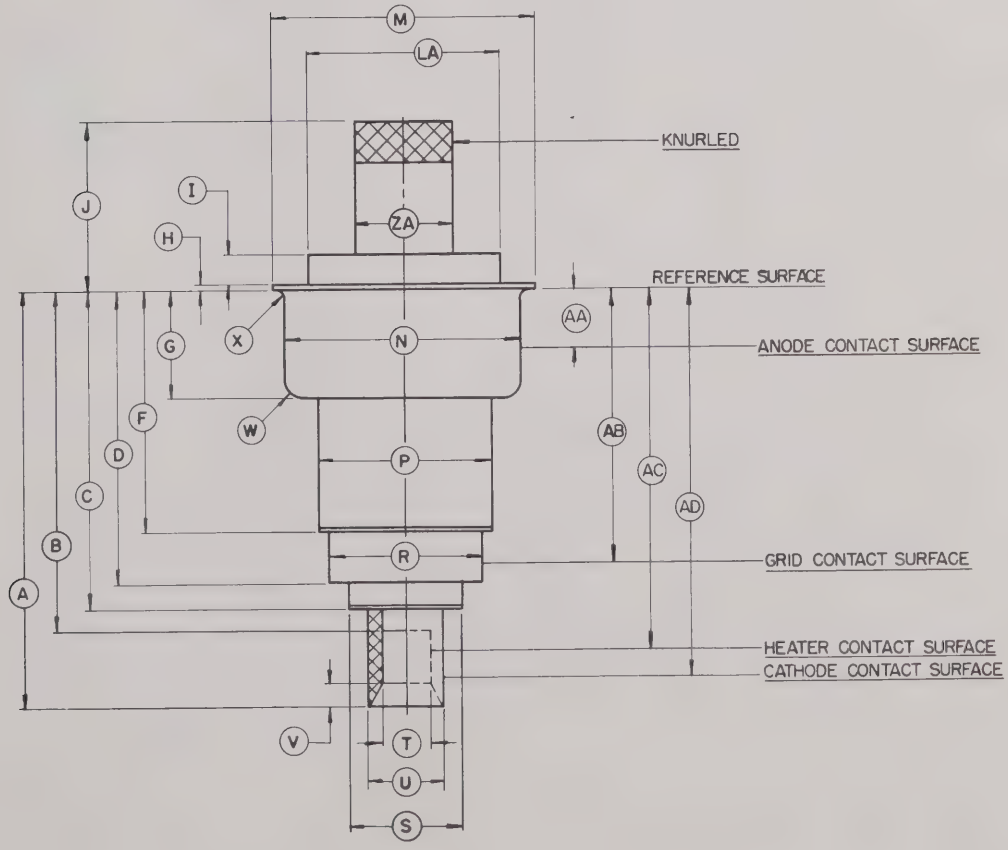
Cathode Operation—The oxide-coated unipotential cathode in this tube must be protected against excessively high emission currents. For all types of operation the maximum rated dc current is 125 milliamperes. In pulse service, current must be limited according to the curve on page 3.

It is recommended that the rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied.

Control Grid Operation—Grid dissipation must not exceed the rated maximum 2.0 watts grid dissipation power. In pulse applications the instantaneous peak grid-to-cathode voltage must be limited to +250 to —750 volts.

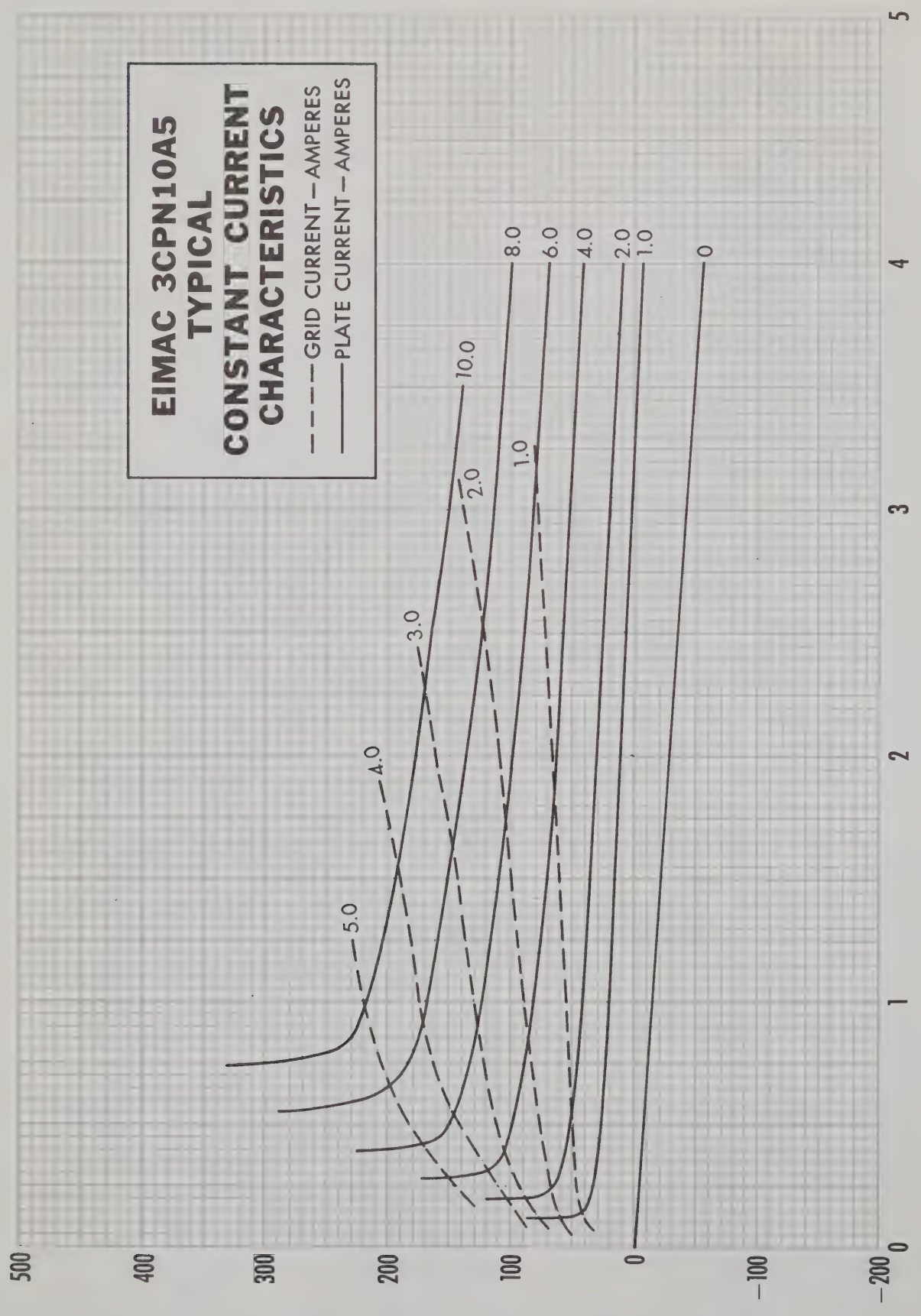
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Division or Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.815	1.875	
B		1.534	
C		1.475	
D	1.289	1.329	
F	.970	1.010	
G	.462	.477	
H		.040	
I		.185	
J	.766	.826	
M	1.180	1.195	
N	1.025	1.035	
P	.772	.792	
R	.655	.665	
S		.545	
T	.213	.223	
U	.315	.325	
V		.086	
W		.100	
X		.035	
LA			.850
ZA	.427	.447	

ELECTRODE CONTACT AREA		
REF		
AA	.198±.163	ANODE
AB	1.225±.040	GRID
AC	1.631±.097	HEATER
AD	1.645±.170	CATHODE


EIMAC 3CPN10A5
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
– – – – GRID CURRENT – AMPERES
——— PLATE CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
4.0
2.0
1.0
0
500
400
300
200
100
0
–100
–200
0
1
2
3
4
5
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

7815R
3CPX100A5
UHF PULSE TRIODE

The EIMAC 7815R/3CPX100A5 is a pulse rated version of the 3CX100A5. A longer grid-anode ceramic insulator is incorporated, making the tube useful at high altitude. The nominal plate dissipation rating is 100 watts.

The tube is usable in pulse applications to 3000 MHz. Electrical characteristics are similar to the 3CX100A5.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-coated, Unipotential				
Heating time	60			seconds
Heater:				
Voltage		6.0		volts
Current	0.90		1.05	amperes
Amplification Factor		100		
Transconductance (1 b = 70 milliamperes)		25,000		Micromhos

Direct Interelectrode Capacitances	Min.	Max.	
Grid-Cathode	5.6	7.0	pF
Grid-Plate	1.86	2.10	pF
Plate-Cathode		0.035	pF
Frequency for Maximum Ratings		3000	MHz

MECHANICAL

Terminals	Graduated Cylindrical Surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Cooling	Forced Air
Maximum Overall Dimensions:	
Length	2.701 inches
Diameter	1.264 inches
Net Weight	2.5 ounces
Shipping Weight (approx.)	7.0 ounces

PLATE PULSED OSCILLATOR OR AMPLIFIER CLASS-C

MAXIMUM RATINGS

Peak Pulse Plate Voltage	3500 volts
DC Grid Voltage	−150 volts
Pulse Plate Current	3.0 volts
DC Cathode Current	125 ma
Pulse Grid Current	1.8 amps
Plate Dissipation (average)	100 watts
Grid Dissipation (average)	2 watts

TYPICAL OPERATION

Pulse Plate Voltage	3500	3500 volts
Pulse Plate Current	3.0	3.0 amps
DC Plate Current (average)	7.5	9 ma
DC Grid Current (average)	4.5	3 ma
Pulse Power Output	1600	2000 watts
Frequency	3000	2500 MHz
Pulse Length	3	5 usec
Duty Factor	0.0025	0.003

(Revised 4-15-67) © 1967 by Varian

Printed in U.S.A.

GRID PULSED OSCILLATOR OR AMPLIFIER
CLASS-C

MAXIMUM RATINGS

DC Plate Voltage	2000 volts
DC Grid Voltage	—150 volts
Pulse Plate Current	3.0 amps
DC Cathode Current	125 ma
Plate Dissipation (average)	100 watts
Grid Dissipation (average)	2 watts

TYPICAL OPERATION

DC Plate Voltage	1600	1700 volts
DC Grid Voltage	—45	—45 volts
Pulse Plate Current	3.0	1.9 amps
Pulse Grid Current	1.8	1.1 amps
Pulse Power Output	1000	1500 watts
Frequency	3000	1100 MHz
Pulse Length	3	3.5 usec
Duty Factor	0.0025	0.001

APPLICATION

MECHANICAL

Mounting—The 3CPX100A5 may be operated in any any position. It should be firmly held in place by spring-finger collets bearing on the terminal surfaces. In use the tube should seat against the underside of the anode-terminal flange which is on the plane of reference for longitudinal dimensions. In applications involving severe shock and vibration, the tube may be clamped in place by applying a suitable clamping device to the anode-terminal flange. It is recommended that no other portion of the tube be subjected to clamping forces.

Connections—The terminals are in the form of concentric cylinders of graduated diameters conveniently used with coaxial tuning devices. Spring-fingered collets should be used to make contact with the anode, grid, cathode and heater terminals. Adequate contact area and spring pressure should be provided to minimize heating and to prevent erratic circuit performance at the higher frequencies. Noncontacting or intermittently-contacting collet fingers will cause troublesome circuit behavior, especially at very-high and ultra-high frequencies. Electrode contact surfaces should be kept clean and free of oxide coatings.

Cooling—Sufficient cooling air must be provided for the anode and body seals to maintain operating temperatures below the rated maximum value of 250°C. At sea level, with 20°C air, approximately 12.5 CFM of cooling air directed across the anode through a suitable cowling will maintain safe anode temperature. In pulse applications requiring low plate dissipation and/or small size, the coolerless 3CPN10A5 should be considered.

The nominal plate dissipation rating is 100 watts.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness, regardless of the coolant type, flow rate or coolant temperature. One method of measuring the surface temperature is the use of temperature sensitive lacquer, such as "Tempilaq."

ELECTRICAL

Heater Operation—The rated heater voltage for the 3CPX100A5 is 6.0 volts. The heater voltage for the 3CPX100A5 should be maintained within plus or minus 5% of its intended value to minimize variations in circuit performance and to obtain maximum tube life.

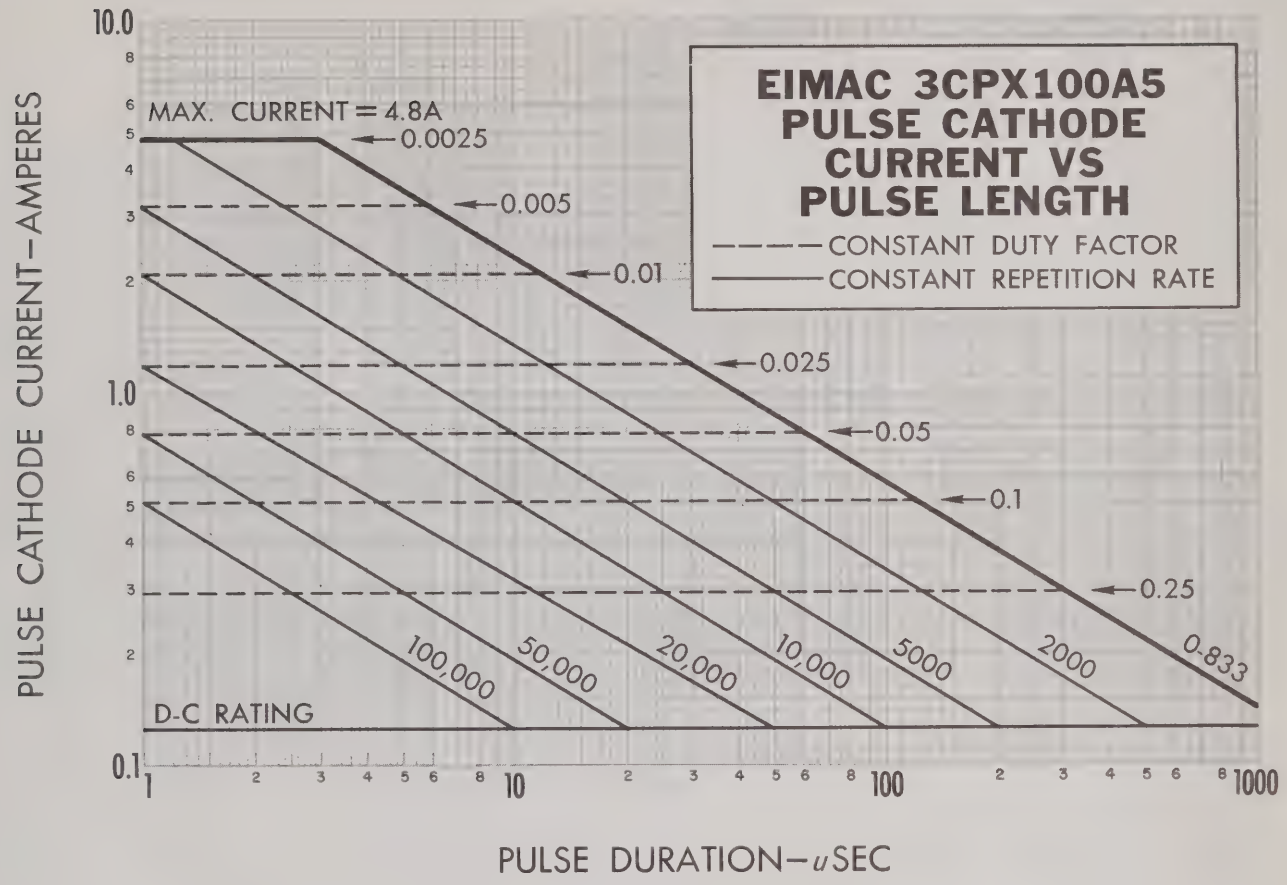
At frequencies above approximately 1000 MHz, transit time effects begin to influence cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, driving power, and duty factor. If the conditions of operation result in appreciable cathode back-heating, it may be necessary to start dynamic tube operation at normal heater voltage followed by a reduction of heater voltage to a lower value. The heater of the 3CPX100A5 must not be operated at less than 4.5 volts in any case.

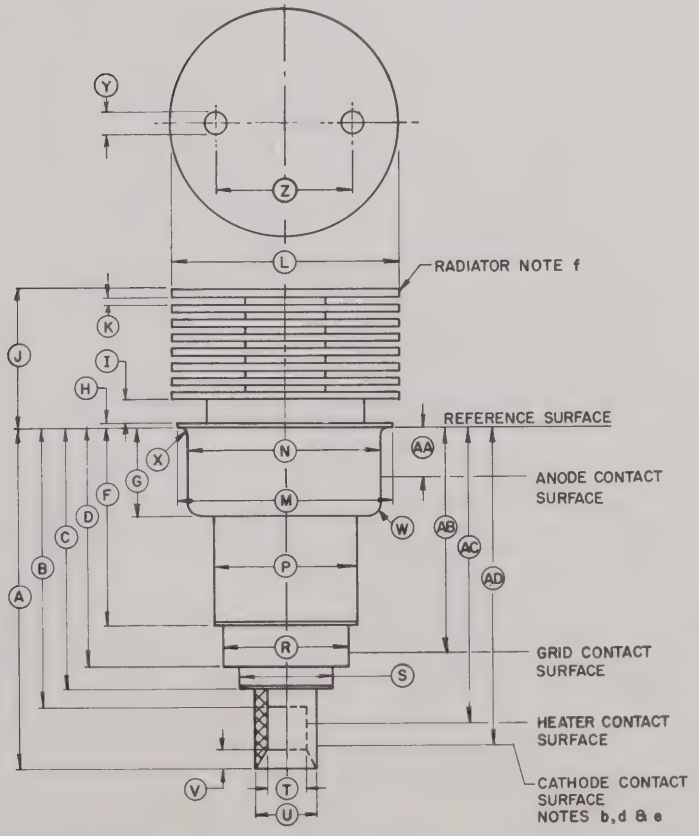
Cathode Operation—The oxide-coated unipotential cathode in this tube must be protected against excessively high emission currents. For all types of operation the maximum rated dc current is 125 milliamperes. In pulse service, current must be limited according to the curve on page 3.

It is recommended that the rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied.

Control Grid Operation—Grid dissipation must not exceed the rated maximum 2.0 watts grid dissipation power. In pulse applications the instantaneous peak grid-to-cathode voltage must be limited to +250 to —750 volts.

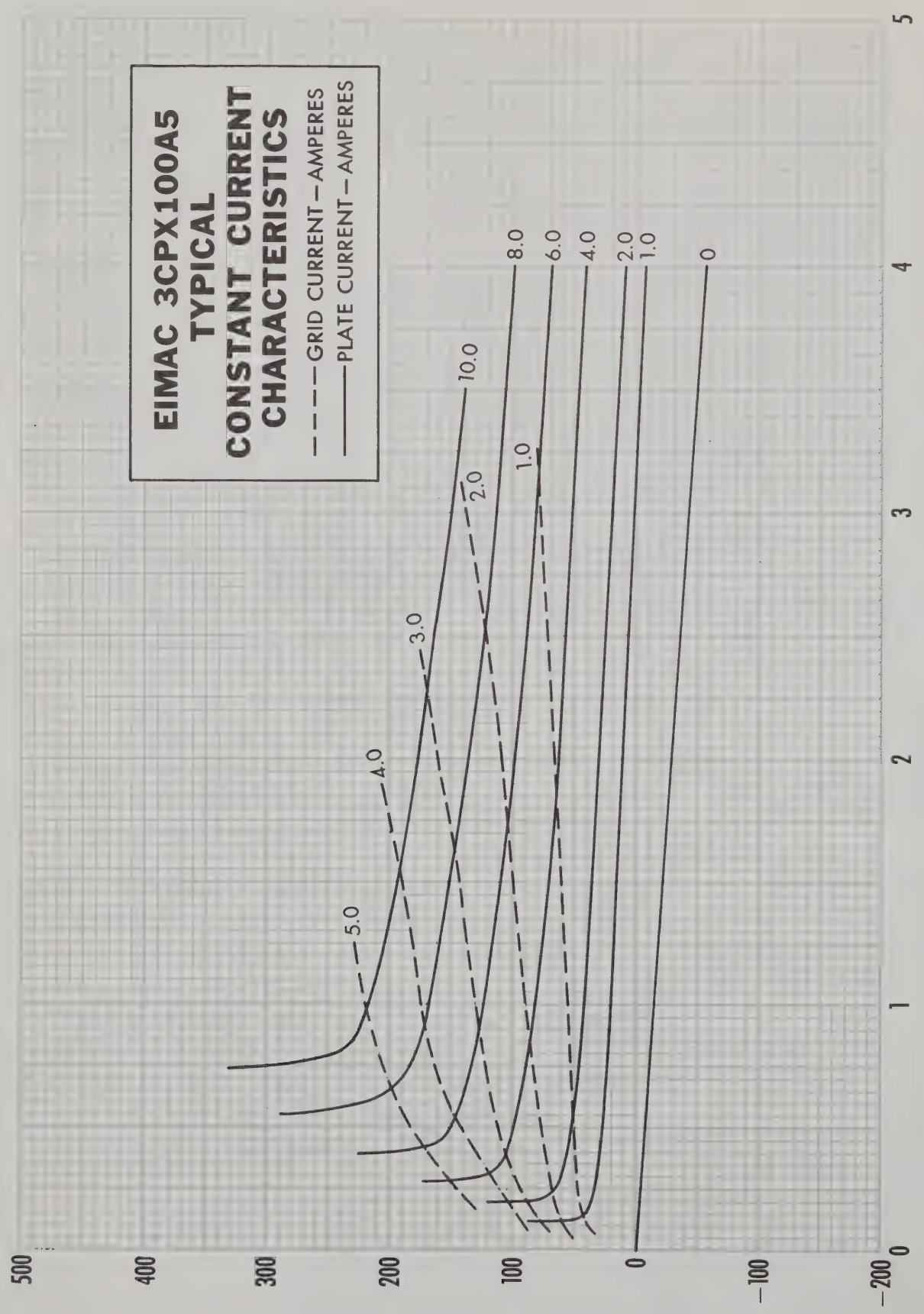
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division or Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.





DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.815	1.875	
B		1.534	
C		1.475	
D	1.289	1.329	
F	.970	1.010	
G	.462	.477	
H		.040	
I	.125	.185	
J	.766	.826	
K	.025	.046	
L	1.234	1.264	
M	1.180	1.195	
N	1.025	1.035	
P	.772	.792	
R	.665	.665	
S		.545	
T	.213	.223	
U	.315	.325	
V		.088	
W		.100	
X		.035	
Y	.105	.145	
Z	.650	.850	
AA	.035	.361	
AB	1.185	1.265	
AC	1.534	1.728	
AD	1.475	1.815	


EIMAC 3CPX100A5
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
– – – – GRID CURRENT – AMPERES
——— PLATE CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
1.0
2.0
4.0
6.0
8.0
10.0
0
500
400
300
200
100
0
–100
–200
0
1
2
3
4
5
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

3CW5000A3

MEDIUM-MU POWER TRIODE

The EIMAC 3CW5000A3 is a water-cooled, medium-mu power triode intended for amplifier, oscillator or modulator service. It has a maximum plate dissipation rating of 5000 watts and is capable of high output at relatively low plate voltages. A single 3CW5000A3 will deliver a radio frequency plate power-output of 7500 watts at a plate voltage of 4000 volts.

Note: The 3CW5000A3 is a water cooled version of the air-cooled 8161/3CX2500A3.

The 3CW5000A3 should be used where water cooling is preferred and for industrial applications or installations where reserve anode dissipation is desired.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor (Average)		20		
Direct Interelectrode Capacitances (Average)				
Grid-Plate	17.8		24.2	pF
Grid-Filament	29.2		40.2	pF
Plate-Filament	0.60		1.20	pF
Transconductance (I_b=830 ma, E_b=3000v)		20,000		μmhos

MECHANICAL

Base	see drawing
Mounting	vertical, base down or up
Maximum Over-all Dimensions:	
Length	12.56 inches
Diameter	3.63 inches
Net Weight	4.8 pounds
Cooling	Water and forced air

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C FM or Telegraphy (Key down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	5000 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION

DC Plate Voltage	4000	5000	6000 volts
DC Plate Current	2.5	2.5	2.08 amps
DC Grid Voltage	—300	—450	—500 volts
DC Grid Current	245	265	180 ma
Peak RF Grid Input Voltage	580	750	765 volts
Driving Power (approx.)	142	197	136 watts
Grid Dissipation	68	78	46 watts
Plate Power Input	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Power Output	7500	10,000	10,000 watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	3350 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION

DC Plate Voltage	4000	4500	5000 volts
DC Plate Current	1.67	1.55	1.45 amps
Total Bias Voltage	—450	—500	—550 volts
Fixed Bias Voltage	—230	—325	—410 volts
Grid Resistor	1500	1500	1400 ohms
DC Grid Current	150	120	100 ma
Peak RF Grid Input Voltage	680	720	760 volts
Driving Power (approx.)	102	86	76 watts
Grid Dissipation	35	26	21 watts
Plate Power Input	6670	6970	7250 watts
Plate Dissipation	1670	1670	1670 watts
Plate Power Output	5000	5300	5580 watts

(Effective 6-1-67) © 1964, 1967 by Varian

Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
MAX-SIGNAL DC PLATE CURRENT, (PER TUBE)	2.5 AMPS
PLATE DISSIPATION, (PER TUBE)	5000 WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	4000	5000	6000 volts
DC Grid Voltage[1]	—150	—190	—240 volts
Zero-Signal DC Plate Current	0.6	0.5	0.4 amps
Max-Signal DC Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.

[1]Adjust to give listed zero-signal plate current.

TYPICAL OPERATION CLASS AB_2 (Two Tubes)

Modulator service for 4000 and 5000 volt operation, to modulate one or two tubes, as shown under "Plate Modulated Radio Frequency Amplifier" (Page 1)

DC Plate Voltage	4000	5000	4000	5000 volts
DC Grid Voltage (approx.)*	—155	—200	—145	—190 volts
Zero-Signal DC Plate Current	0.4	0.4	0.6	0.5 amps
Max-Signal DC Plate Current	1.35	1.13	2.70	2.26 amps
Effective Load, Plate to Plate	6600	10,000	3300	5000 ohms
Peak AF Grid Input Voltage (per tube)	240	275	285	310 volts
Max-Signal Peak Driving Power	42	40	134	118 watts
Max-Signal Nominal Driving Power (approx.)	21	20	67	59 watts
Max-Signal Plate Power Output	3700	4000	7400	8000 watts
Will Modulate one Tube RF Final Input of	6670	7250		watts
Will Modulate two Tubes RF Final Input of			13,340	14,500 watts

*Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE POWER GRID MARKETING, EIMAC DIVISION OF VARIAN, 301 INDUSTRIAL WAY, SAN CARLOS, CALIFORNIA, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Cooling — Minimum recommended water-flow rate and pressure drop values for different water-inlet temperatures and plate dissipations are tabulated on the opposite page. The outlet water temperature must not exceed a maximum of 70°C under any conditions. The inlet water pressure must not exceed a maximum of 60 pounds per square inch.

The grid-terminal contact surface and adjacent ceramic must be cooled by forced air. The quantity, velocity and direction must be adjusted to limit the maximum seal temperature to 200°C.

The filament stem structure also requires forced-air cooling. A minimum of 6 cubic feet per minute must be directed into the space between the inner and outer filament contacting surfaces.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage — The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

Bias Voltage — There is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage — The plate supply voltage for the 3CW5000A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

In Class-C FM or Telegraphy service, a 0.1 henry choke, shunted by a spark gap, should be series connected between the plates of the amplifier tubes and the high voltage plate supply capacitor to offer protection from transients and surges. In plate modulated service, where a plate modulation transformer is used, the protective choke is not normally required.

Grid Dissipation — The power dissipated by the grid of the 3CW5000A3 must never exceed 150 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

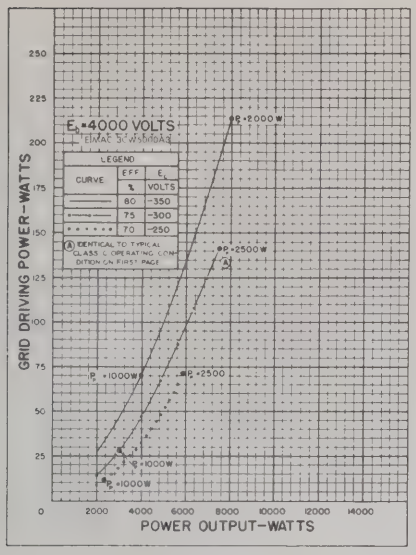
where P_g = Grid dissipation,

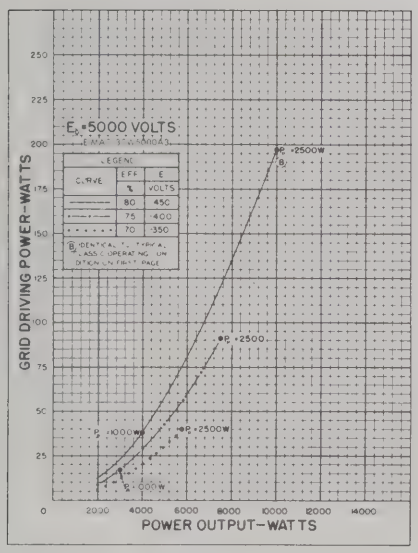
e_{cmp} = Peak positive grid voltage, and

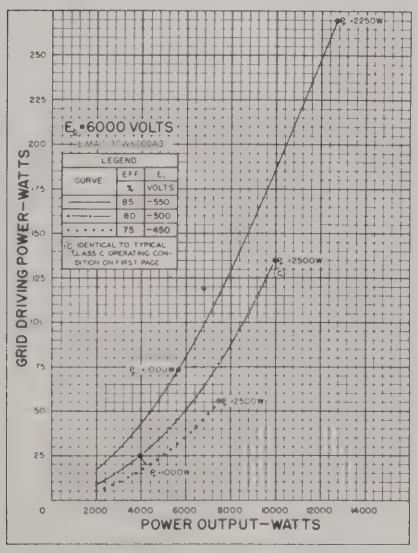
I_c = DC grid current

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. Any suitable peak v.t.v.m. circuit may be used.

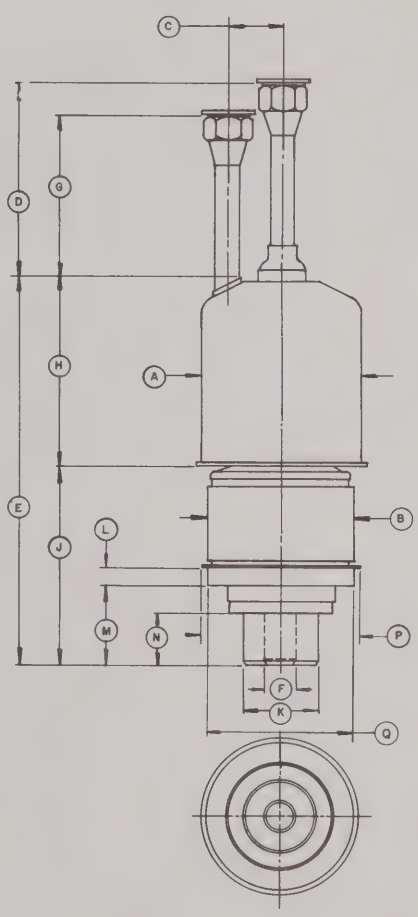
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.







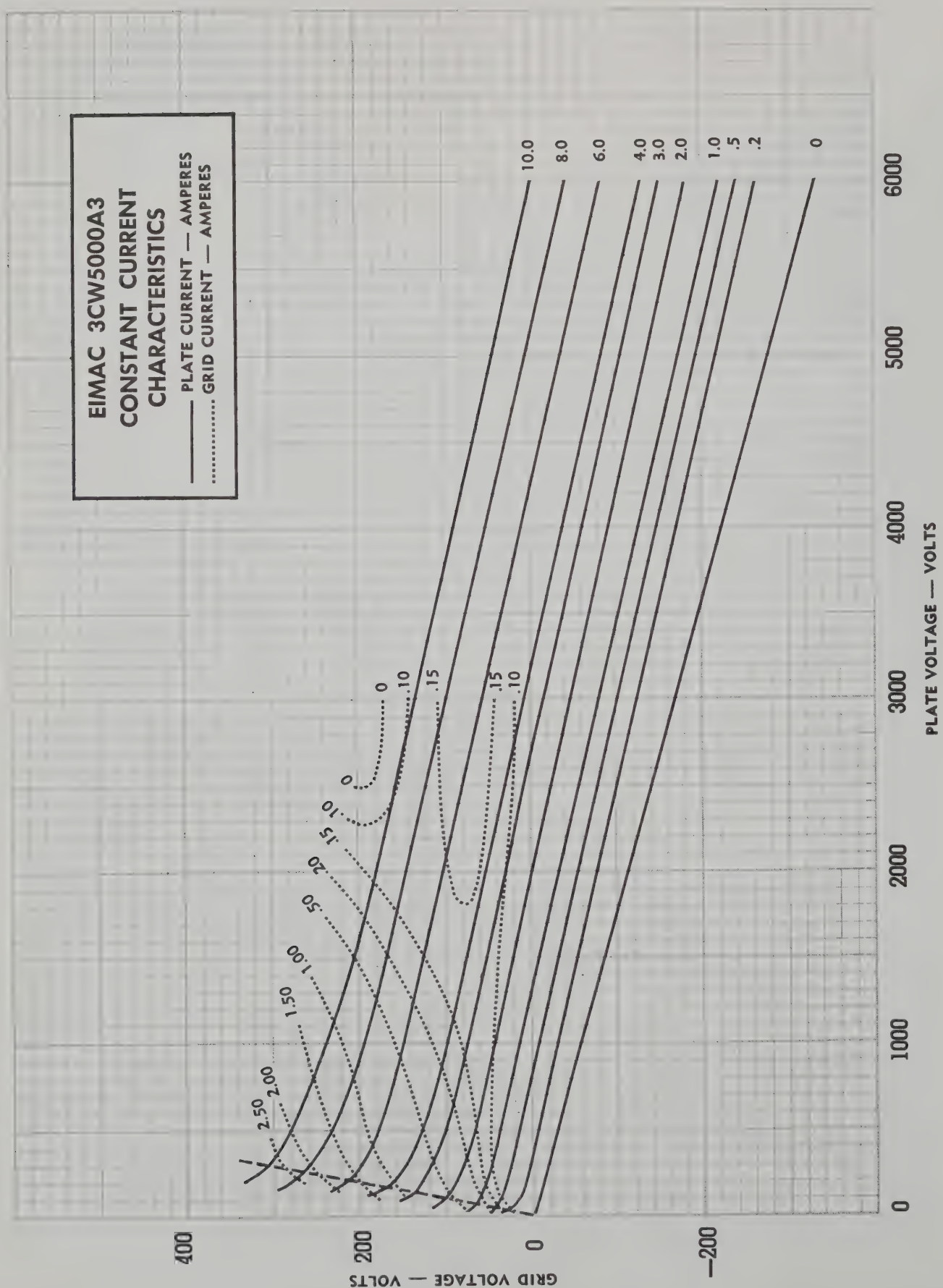
MINIMUM WATER COOLING REQUIREMENTS								
Water Inlet Temp. (°C)	Plate Dissipation							
	2 KW		3 KW		4 KW		5 KW	
	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI
20	1.7	0.68	2.6	1.3	3.9	2.3	5.6	3.9
30	2.3	1.1	3.2	1.7	4.5	2.8	6.2	4.5
40	3.0	1.6	3.8	2.2	5.3	3.5	6.9	5.3
50	3.9	2.3	4.7	3.0	6.0	4.3	7.7	6.1



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.234	3.266
B			3.625
C		1.062	1.187
D		4.000	4.500
E		7.562	8.062
G		3.250	3.750
H		3.625	3.875
J		3.937	4.187
L		.375	.437
M		1.437	1.562
N		.812	.937
R		1.490	1.510
X		.615	.635
Y		2.990	3.010

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3CW5000A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
.10
.15
.15
.10
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
400
200
0
—200
GRID VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

3CX3000A7

HIGH-MU
POWER TRIODE

The EIMAC 3CX3000A7 is a ceramic to metal, high-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 3000 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX3000A7 is an exact replacement for the EIMAC 3X3000A7 and is suggested for use where higher ambient temperatures are to be expected, or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.



The tube has a rugged, low inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals.

The 3CX3000A7 is intended to be used as a zero bias class B amplifier in audio or radio frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive, since a power gain of over twenty times can be obtained.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten		
Voltage	7.5	volts
Current	51	amperes
Amplification Factor	160	
Interelectrode Capacitances:		
Grid-Filament	38	pF
Grid-Plate	24	pF
Plate-Filament	0.6	pF

MECHANICAL

Base	See outline drawing
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core and Seals	250°C
Maximum Dimensions:	
Height	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds
Shipping Weight	17 pounds

(Effective 5-15-67) © 1967 Varian

Printed in U.S.A.

RF LINEAR AMPLIFIER CLASS-B, GROUNDED-GRID

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	3	KW
GRID DISSIPATION	225	WATTS

*Approximate value

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	4000	4800	4800	volts
Zero-Signal DC Plate Current*	.250	.350	.325	amps
Max-Signal DC Plate Current	2.00	1.68	2.0	amps
Max-Signal DC Grid Current	.610	.462	.596	amps
Driving Impedance	47.5	50	46.3	ohms
Resonant Load Impedance	1210	1720	1425	ohms
Max-Signal Driving Power	420	293	410	watts
Peak Envelope Plate Output Power	6030	6000	7266	watts
Power Gain	14.3	20.4	17.70	times
Plate Dissipation	2285	2275	2775	watts

RF LINEAR AMPLIFIER CARRIER CONDITIONS, GRID-DRIVEN

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	3	KW
GRID DISSIPATION	225	WATTS

*Approximate value

TYPICAL OPERATION, Carrier Conditions

DC Plate Voltage	4000	volts
DC Grid Voltage	0	volts
Zero-Signal DC Plate Current*	.250	amps
DC Plate Current	.740	amps
DC Grid Current	.135	amps
Peak Driving Voltage	85	volts
Driving Power	11.5	watts
Plate Output Power	1130	watts
Plate Dissipation	1830	watts
Peak RF Plate Voltage	2000	volts
Resonant Load Impedance	1750	ohms

AF AMPLIFIER OR MODULATOR CLASS-B, GRID-DRIVEN

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	3	KW
GRID DISSIPATION	225	WATTS

*Approximate value

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	4000 volts
DC Grid Voltage	0 volts
Zero-Signal DC Plate Current*	.500 amps
Max-Signal DC Plate Current	3.575 amps
Max-Signal DC Grid Current	.585 amps
Driving Power	115 watts
Peak AF Driving Voltage (per tube)	190 volts
Load Resistance, Plate-to-Plate	2720 ohms
Max-Signal Plate Output Power	10,500 watts
Plate Dissipation (per tube)	1850 watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

Input Circuit — When the 3CX3000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

Cooling—The maximum temperature rating for the anode core and seals of the 3CX3000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperatures of the ceramic-to-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below the maximum rating. Minimum air flow requirements to maintain anode-core and seal temperatures below 250°C at sea level with an inlet-air temperature of 50°C are tabulated for air-flow in the anode-to-base and base-to-anode directions. At higher ambient temperatures, frequencies above 30 MHz or at higher altitude, a greater quantity of air will be required. It is suggested that temperatures be monitored in any new installation to insure proper cooling.

Anode-to-Base Air Flow[1]

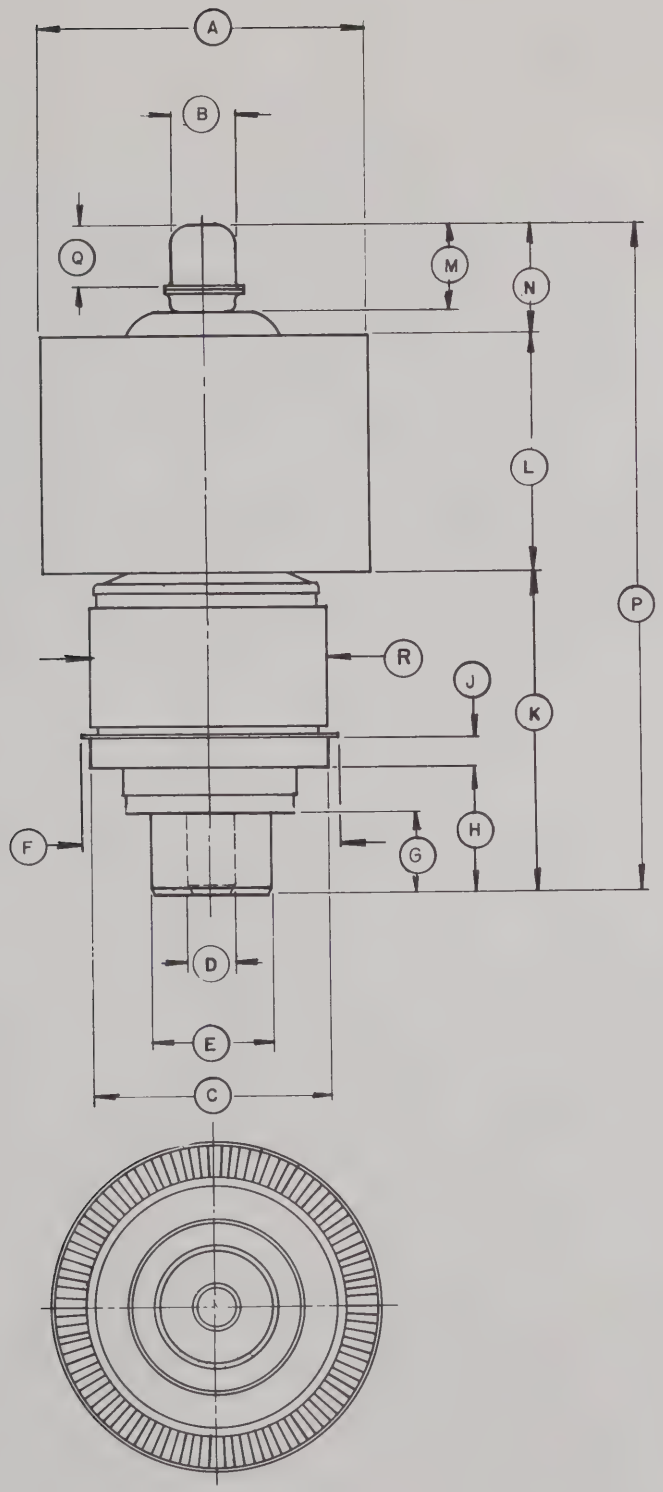
	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	33	.6	48	.9
2500	66	1.25	96	1.82
3000	72	1.40	105	2.04

Base-to-Anode Air Flow

	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	32	.6	47	.9
2500	57	1.0	83	1.5
3000	64	1.07	93.4	1.56

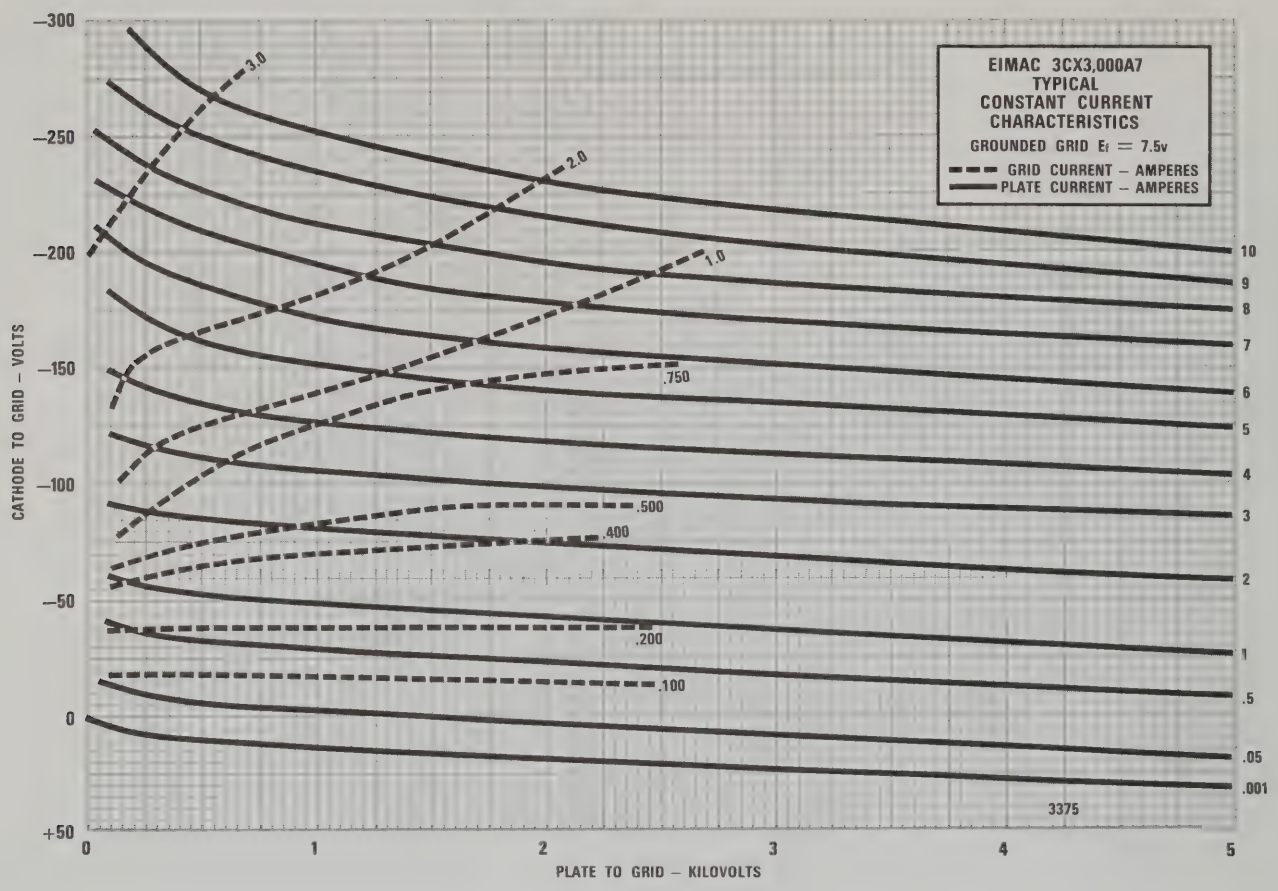
*Since the power dissipated by the filament represents about 385 watts and since grid dissipation can, under some conditions represent another 225 watts, allowance has been made in preparing this tabulation for an additional 610 watts.

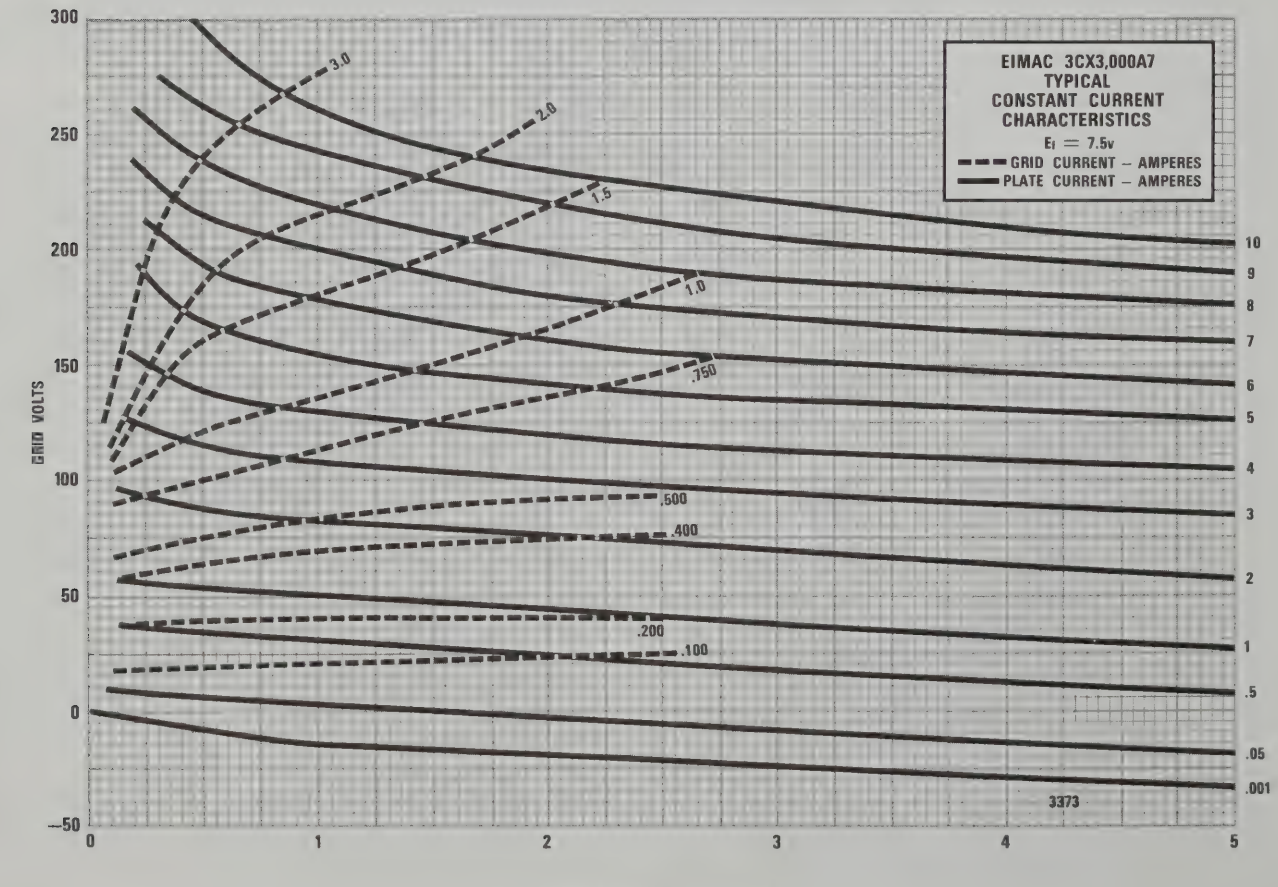
[1]When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.



DIMENSIONS IN INCHES.

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4-3/32	4-5/32	
B	25/32	27/32	
C	2.990	3.010	
D	.615	.635	
E	1.490	1.510	
F		3-5/8	
G	13/16	15/16	
H	1-3/8	1-5/8	
J	25/64	27/64	
K	3-7/8	4-1/4	
L	2-15/16	3-1/16	
M	1	1-1/8	
N	1-3/16	1-11/16	
P	8	9	
Q	11/16	13/16	
R	2.998	3.002	


EIMAC 3CX3,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID Ef = 7.5v
GRID CURRENT – AMPERES
PLATE CURRENT – AMPERES
CATHODE TO GRID – VOLTS
PLATE TO GRID – KILOVOLTS
3375


EIMAC 3CX3,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 7.5v
GRID CURRENT – AMPERES
PLATE CURRENT – AMPERES
GRID VOLTS
PLATE VOLTAGE — KILOVOLTS
3373

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8160
3CX10,000A7

HIGH-MU POWER TRIODE

The EIMAC 8160/3CX10,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8160/3CX10,000A7.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amps
Amplification Factor		200		
Direct Interelectrode Capacitances:				
Grid-Filament	50.0		62.0	pF
Grid-Plate	32.0		40.0	pF
Plate-Filament			0.3	pF
Frequency for Maximum Ratings			160	MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1300
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	8.75 inches
Diameter	7.05 inches
Net Weight	12 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Grounded Grid, Class-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	12 KW
GRID DISSIPATION	500 WATTS

*Approximate value

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000 volts
Zero-Sig DC Plate Current*	0.60	0.60 amp
Max-Sig DC Plate Current	3.72	5.00 amps
Max-Sig DC Grid Current	0.71	1.00 amp
Driving Impedance	35	32 ohms
Resonant Load Impedance	1020	745 ohms
Max-Sig Driving Power	885	1540 watts
Peak Envelope Plate Output Power	17,700	24,200 watts
Power Gain	20.0	15.7 times

(Revised 6-1-67) © 1963, 1967 by Varian

Printed in U.S.A.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-B, Grid Driven

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	12 KW
GRID DISSIPATION	500 WATTS

*Approximate value

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000	volts
DC Grid Voltage	0	0	volts
Zero-Sig DC Plate Current*	1.20	1.20	amps
Max-Sig DC Plate Current	7.50	10.0	amps
Max-Sig DC Grid Current	1.50	2.06	amps
Driving Power	315	560	watts
Peak AF Driving Voltage (Per Tube)	250	310	volts
Load Resistance, Plate-to-Plate	2000	1520	ohms
Max-Sig Plate Output Power	35,600	47,700	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Carrier Conditions, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	12 KW
GRID DISSIPATION	500 WATTS

*Approximate value
**Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	0.60 amp
DC Plate Current	2.40 amps
DC Grid Current	0.25 amp
Driving Impedance**	32 ohms
Peak Driving Voltage**	310 volts
Driving Power	330 watts
Plate Output Power	5650 watts

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	10 KW
GRID DISSIPATION	500 WATTS

TYPICAL OPERATION

DC Plate Voltage	7000 volts
DC Plate Current	4.0 amps
DC Grid Voltage	–230 volts
DC Grid Current	775 mA
Peak RF Grid Voltage	555 volts
Grid Driving Power	430 watts
Plate Output Power	21.3 kW

PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 VOLTS
DC PLATE CURRENT	3.0 AMPS
PLATE DISSIPATION	6.5 KW
GRID DISSIPATION	500 WATTS

TYPICAL OPERATION

DC Plate Voltage	5000 volts
DC Plate Current	3.0 amps
DC Grid Voltage	–200 volts
DC Grid Current	775 mA
Peak RF Grid Voltage	490 volts
Grid Driving Power	380 watts
Plate Output Power	11.9 kW

Note: "TYPICAL OPERATION" data are obtainable by calculation from published characteristic curves. No allowance for circuit losses, either input or output, has been made.

APPLICATION

Mounting—The 3CX10,000A7 must be operated vertically base up or down. The tube must be protected from severe vibration and shock.

Cooling — The maximum temperature rating for the external surfaces of the 3CX10,000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate** Dissipation (Watts)	Sea Level		10,000 Feet	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	105	.24	154	.35
6000	178	.50	275	.80
8000	253	.90	370	1.45
10,000	345	1.4	500	2.30
12,000	483	2.25	710	3.40

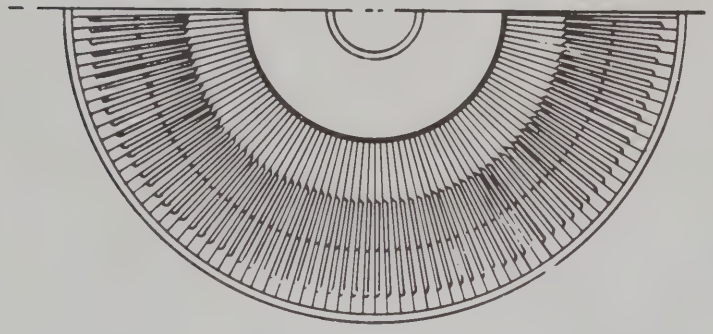
**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1250 watts dissipation.

Input Circuit — When the 3CX10,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

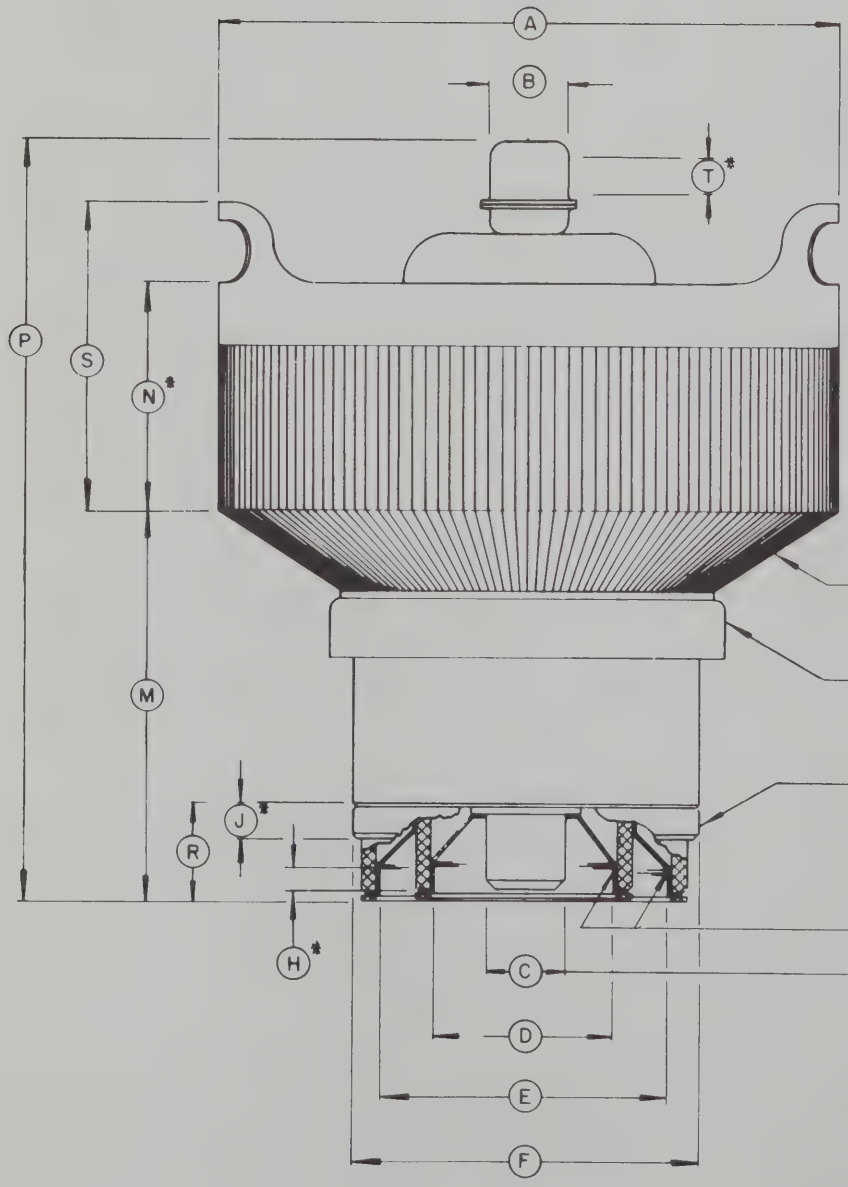
Class-C Operation — Although specifically designed for class-B service, the 3CX10,000A7 may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3CX10,000A7 can be used to advantage in class-C amplifiers by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

Filament Operation — The rated filament voltage for the 3CX10,000A7 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

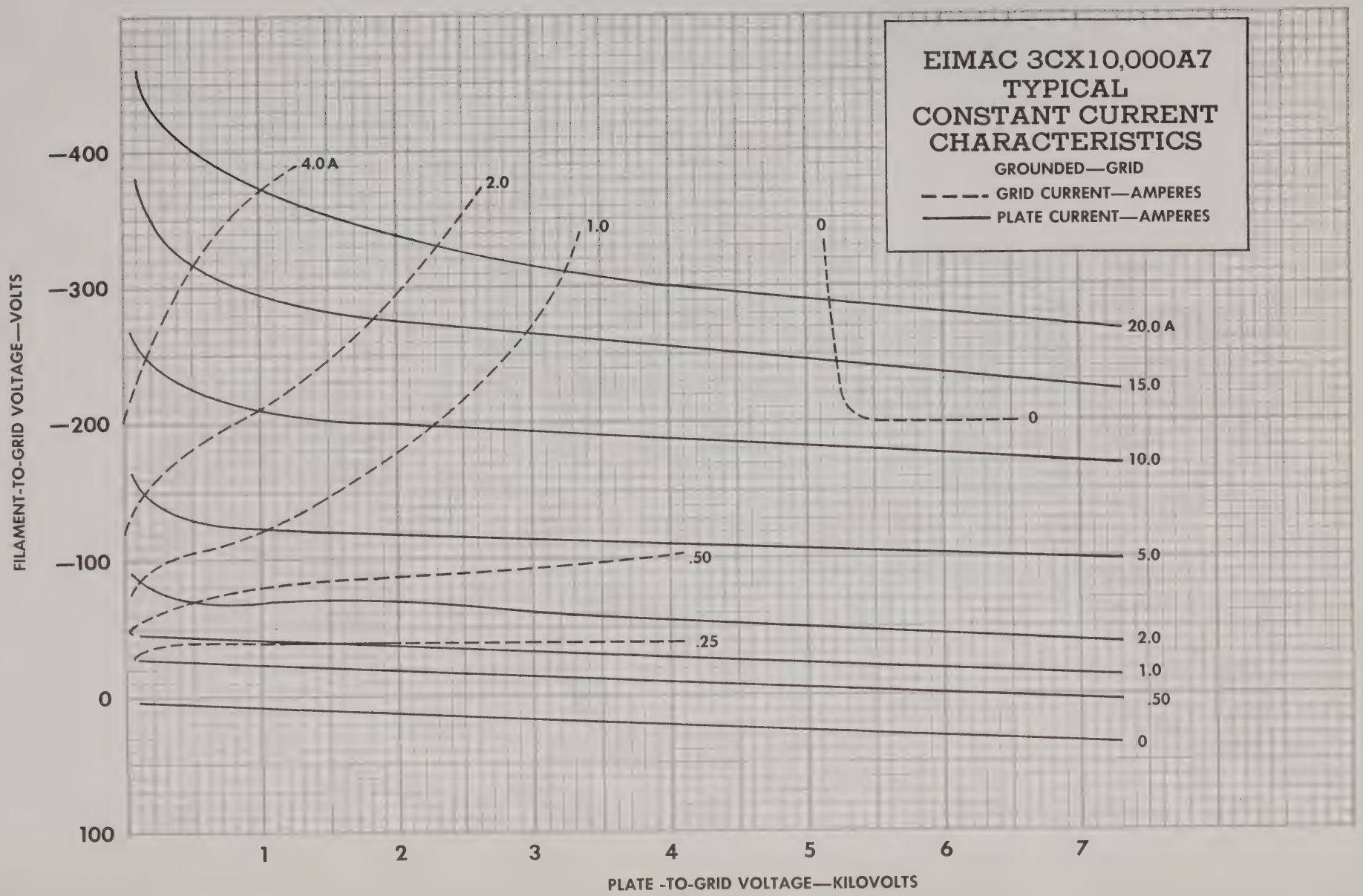
Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

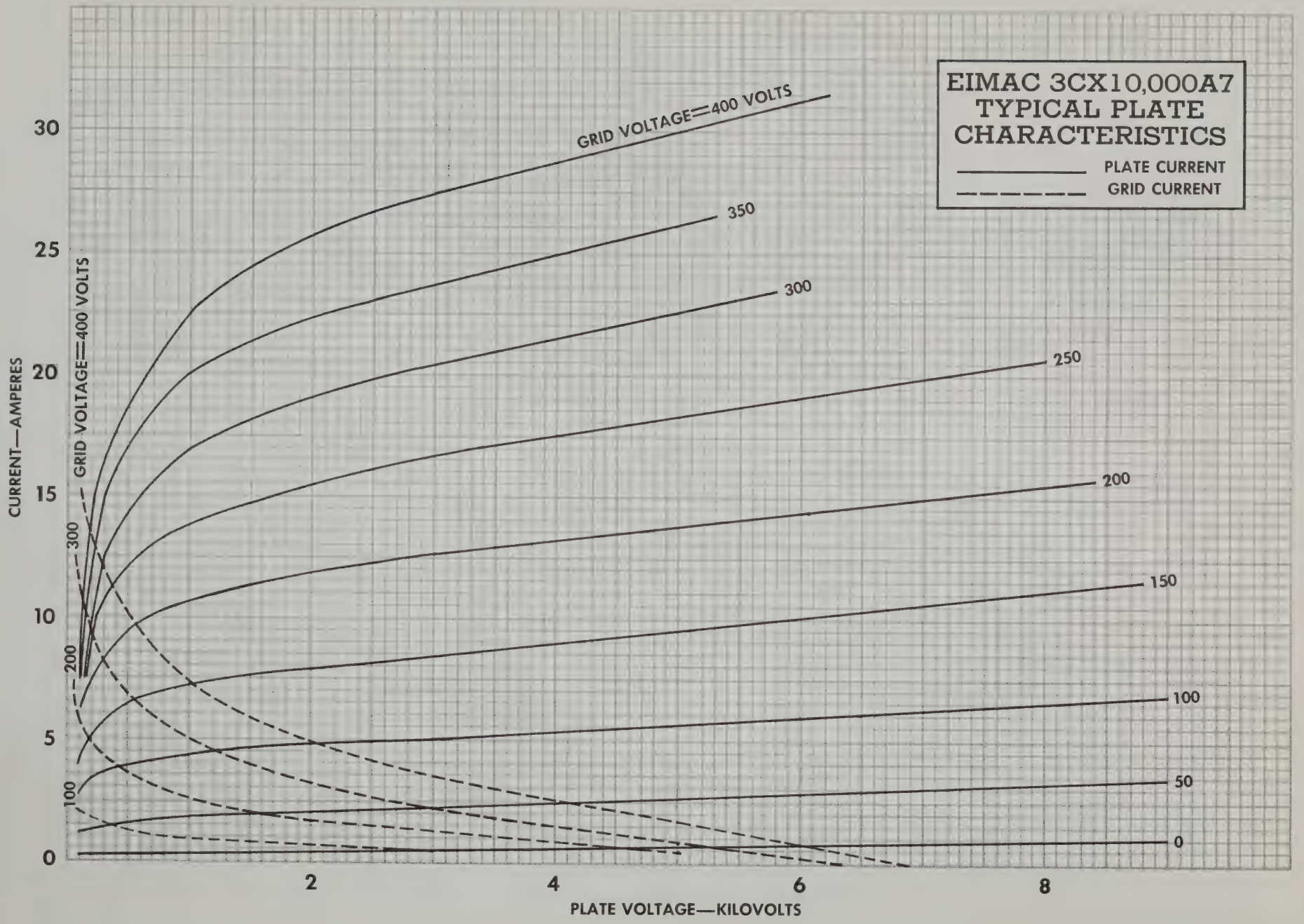


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
FILAMENT-TO-GRID VOLTAGE—VOLTS
−400
−300
−200
−100
0
100
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE—KILOVOLTS
4.0 A
2.0
1.0
0
20.0 A
15.0
0
10.0
5.0
.50
.25
2.0
1.0
.50
0


EIMAC 3CX10,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE=400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE=400 VOLTS
300
200
100
CURRENT—AMPERES
0
5
10
15
20
25
30
2
4
6
8
PLATE VOLTAGE—KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

35TG

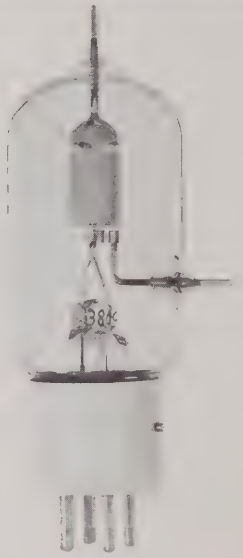
HIGH-MU TRIODE

●

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 35TG is a high-mu triode having a maximum plate dissipation of 50 watts. It is intended for use as an amplifier, oscillator or modulator, and can be used at its maximum ratings at frequencies up to 100 MHz. It is basically the same as the EIMAC 35T except that the grid terminal is located at the side of the bulb.

The 35TG is cooled by radiation and by free circulation of air around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		5.0		volts
Current	3.6		4.2	amps
Amplification Factor	35		43	
Direct Interelectrode Capacitances:				
Grid-Plate	1.25		2.05	pF
Grid-Filament	2.00		3.20	pF
Plate-Filament	0.10		0.35	pF
Transconductance (I_b = 100 mA)		2850		umhos
Frequency for Maximum Ratings			100	MHz

MECHANICAL

Base: UX Medium 4-pin. Fits E. F. Johnson Co. 122-124, or National XC-4 or CIR-4 sockets.

Basing	See outline drawing
Mounting	Vertical, base down or up
Cooling	Convection and radiation
Recommended Heat Dissipating Plate Connector	EIMAC HR-3
Maximum Overall Dimensions:	
Length	5.5 inches
Diameter	1.8 inches
Net weight	2.5 ounces
Shipping weight (Average)	1.25 pounds

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC Plate Voltage	2000	volts
DC Plate Current	150	mA
Plate Dissipation	50	watts
Grid Dissipation	15	watts

TYPICAL OPERATION

DC Plate Voltage	600	1000	1500	2000	volts
DC Grid Voltage (approx.)*	0	−8	−25	−40	volts
Zero-signal DC Plate Current	90	67	45	34	mA
Max-signal DC Plate Current	300	240	200	167	mA
Effective Load Plate-to-Plate	4250	7900	16,200	27,500	ohms
Peak AF Input Voltage (per tube)	130	240	250	255	volts
Peak Driving Power (approx.)	18	14	10	8	watts
Nominal Driving Power (app.)	9	7	5	4	watts
Max-signal Plate Power Output	95	140	200	235	watts

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)[1]

MAXIMUM RATINGS

DC Plate Voltage	2000	volts
DC Plate Current	150	mA
Plate Dissipation	50	watts
Grid Dissipation	15	watts

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Grid Voltage	−60	−120	−135 volts
DC Plate Current	125	125	125 mA
DC Grid Current	40	40	45 mA
Peak RF Grid Input Voltage	165	250	285 volts
Driving Power (approx.)	7	9	13 watts
Grid Dissipation	4.2	5.0	6.8 watts
Plate Power Input	125	188	250 watts
Plate Dissipation	38	47	50 watts
Plate Power Output	87	141	200 watts

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)[1]

MAXIMUM RATINGS

DC Plate Voltage	1600	volts
DC Plate Current	120	mA
Plate Dissipation	33	watts
Grid Dissipation	15	watts

TYPICAL OPERATION

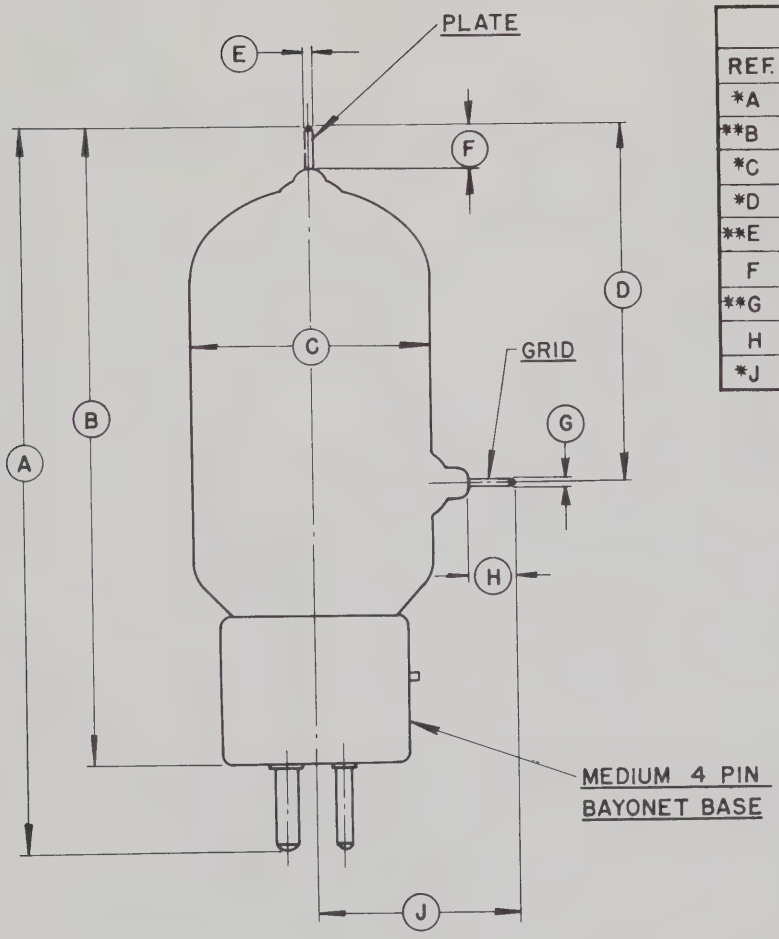
DC Plate Voltage	750	1000	1500 volts
DC Grid Voltage	−100	−125	−150 volts
DC Plate Current	95	100	90 mA
DC Grid Current	40	40	40 mA
Peak RF Driving Voltage (approx.)	210	240	270 volts
Driving Power (approx.)	9	10	11 watts
Plate Dissipation	20	25	30 watts
Plate Input	70	100	135 watts
Plate Power Output	50	75	105 watts

*Adjust for stated zero-signal plate current.

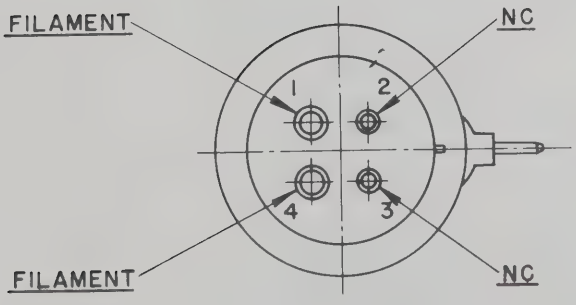
[1] The performance figures listed under Typical Operation are for radio frequencies up to the VHF region and are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power given includes power taken by the tube grid and the bias circuit. The driving power and output power do not allow for losses in the associated resonant circuits. These losses are not included because they depend principally upon the design and choice of the circuit components.

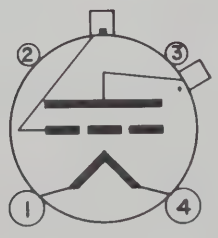
(Revised 6-1-67) © 1958, 1967 by Varian

Printed in U.S.A.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
*A		5 3/8	5 3/4
**B		4 3/4	5 1/8
*C			1.813
*D		2.060	2.680
**E		.065	.071
F		.312	
**G		.065	.071
H		.312	
*J		1.370	1.630





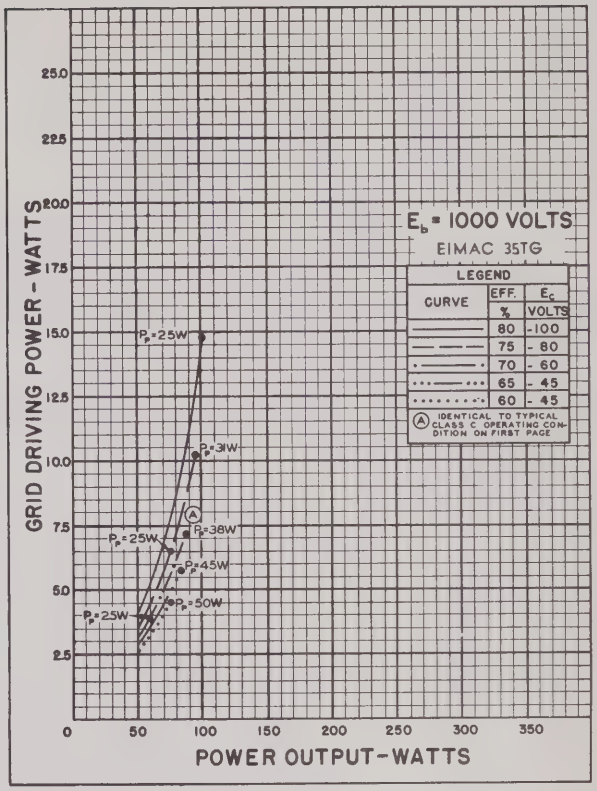
NOTES:

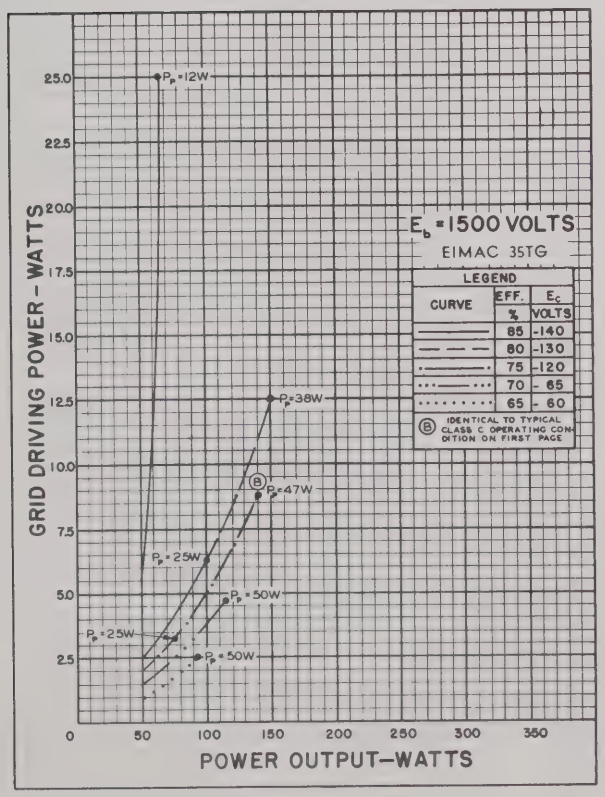
1. DIMENSIONS IN INCHES.
2. *STANDARD DESIGN TESTS & QUALIFICATION TESTS.
3. **QUALIFICATION TESTS.

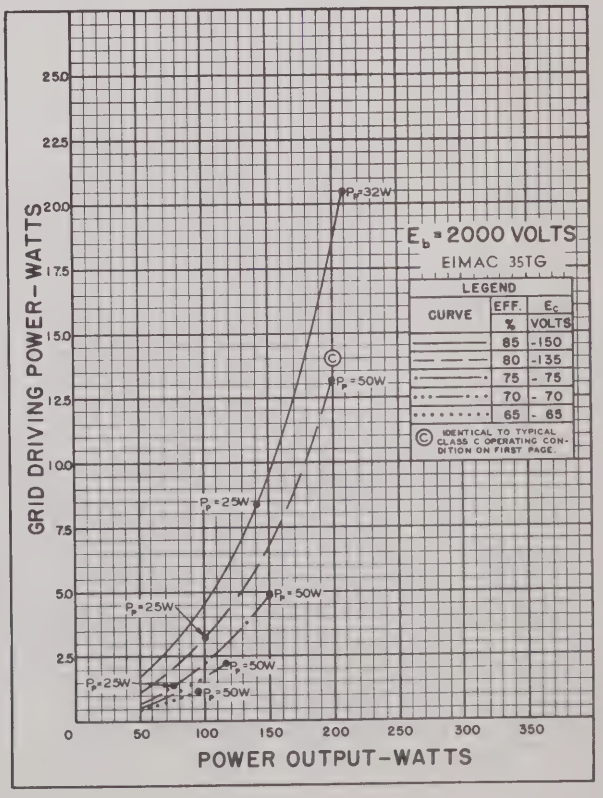
DRIVING POWER vs. POWER OUTPUT

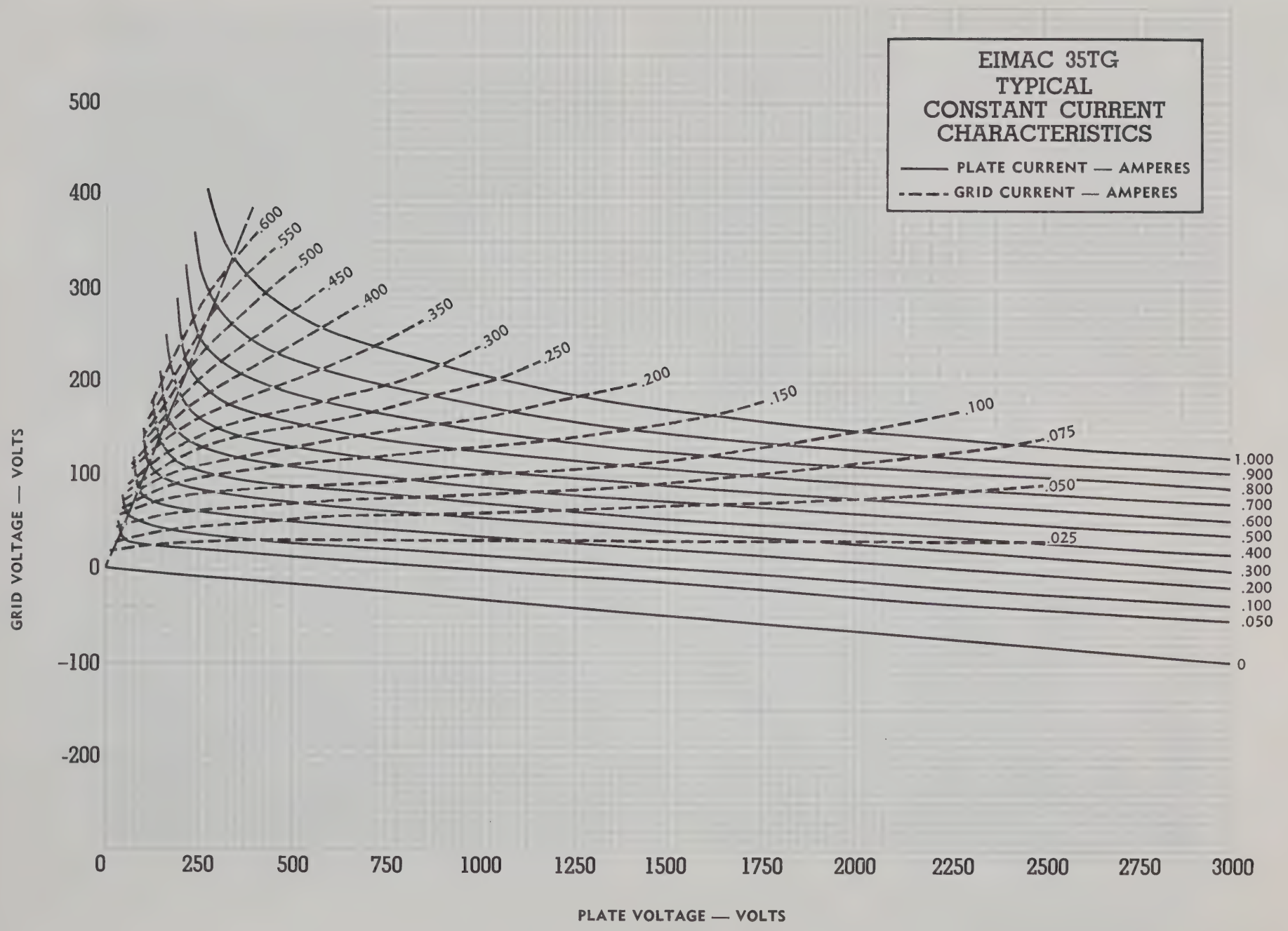
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.








EIMAC 35TG
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
500
400
300
200
100
0
-100
-200
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
.600
.550
.500
.450
.400
.350
.300
.250
.200
.150
.100
.075
.050
.025
1.000
.900
.800
.700
.600
.500
.400
.300
.200
.100
.050
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

304TL

LOW-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 304TL is a low-mu, power triode having a maximum plate dissipation rating of 300 watts, and is intended for use as an amplifier, oscillator or modulator, where maximum performance can be obtained at low plate voltage. It can be used at its maximum ratings at frequencies as high as 40 MHz.

Cooling of the 304TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten		
Voltage	5.0 or 10.0	volts
Current	25.0 or 12.5	amps
Amplification Factor (Average)	12	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	8.6	pF
Grid-Filament	12.1	pF
Plate-Filament	.8	pF
Transconductance (I_b= 1.0 amp, E_b= 3000 V, e_c= —175 V)	16,700	μmhos
Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	Special 4 pin, No. 5000B
Socket	Johnson No. 124-213 or Equivalent
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connectors:	
Plate	HR-7
Grid	HR-6
Maximum Overall Dimensions:	
Length	7.625 inches
Diameter	3.563 inches
Net Weight	9 ounces
Shipping Weight (Average)	2 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS
GRID DISSIPATION	50 WATTS

TYPICAL OPERATION*

DC Plate Voltage	1500	2000	3000 Volts
DC Grid Voltage	—250	—300	—400 Volts
DC Plate Current	665	600	500 mA
DC Grid Current	90	85	80 mA
Peak RF Grid Input Voltage	430	480	575 Volts
Driving Power (approx.)	33	36	40 Watts
Grid Dissipation	11	11	8 Watts
Plate Power Input	1000	1200	1500 Watts
Plate Dissipation	300	300	300 Watts
Plate Power Output	700	900	1200 Watts

*The figures show actual measured tube performance, and do not allow for circuit losses.

(Effective 6-1-67) © 1958, 1965, 1967 Varian

Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	900 MA
PLATE DISSIPATION, PER TUBE	300 WATTS

TYPICAL OPERATION, CLASS AB_1

DC Plate Voltage	1500	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—118	—170	—230	—290 Volts
Zero-signal DC Plate Current	270	200	160	130 mA
Max-Signal DC Plate Current	572	546	483	444 mA
Effective Load, Plate-to-Plate	2540	5300	8500	12,000 Ohms
Peak AF Grid Input Voltage (per tube)	118	170	230	290 Volts
Max-Signal Peak Driving Power	0	0	0	0 Watts
Max-Signal Plate Power Output	256	490	610	730 Watts

*Adjust to give stated zero-signal plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION, CLASS AB_2

DC Plate Voltage	1500	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—118	—170	—230	—290 Volts
Zero-signal DC Plate Current	270	200	160	130 mA
Max-Signal DC Plate Current	1140	1000	900	800 mA
Effective Load, Plate-to-Plate	2750	4500	6600	9100 Ohms
Peak AF Grid Input Voltage (per tube)	245	290	340	390 Volts
Max-Signal Peak Driving Power	78	87	95	110 Watts
Max-Signal Nominal Driving Power (approx.)	39	44	48	55 Watts
Max-Signal Plate Power Output	1100	1400	1650	1800 Watts

*Adjust to give stated zero-signal plate current

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC PLATE CURRENT	700 MA
PLATE DISSIPATION	200 WATTS
GRID DISSIPATION	50 WATTS

TYPICAL OPERATION (Power input limited to 500 and 1000 watts)*

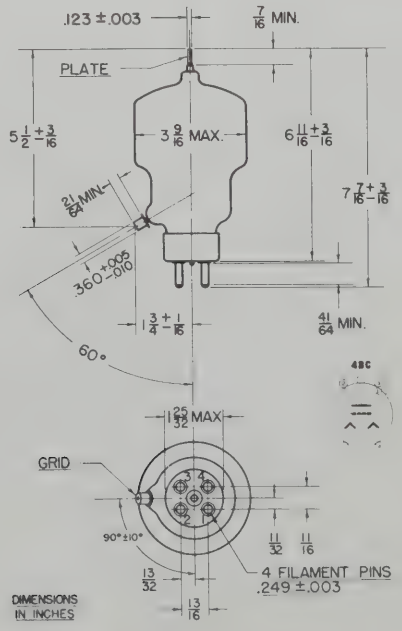
DC Plate Voltage	2000	2000	2500	2500 Volts
DC Plate Current	250	500	200	400 mA
Total Bias Voltage	—500	—500	—525	—550 Volts
Fixed Bias Voltage	—410	—275	—300	—300 Volts
Grid Resistor	3000	3000	12,500	5000 Ohms
DC Grid Current	30	75	18	50 mA
Peak RF Grid Input Voltage	615	690	620	715 Volts
Driving Power	18	52	11	36 Watts
Grid Dissipation	3	15	2	9 Watts
Plate Power Input	500	1000	500	1000 Watts
Plate Dissipation	90	190	75	170 Watts
Plate Power Output	410	810	425	830 Watts

*The figures are for convenience in obtaining a 500 or 1000 Watt carrier input per tube to the modulated amplifier. The output figures do not allow for circuit losses.

TYPICAL OPERATION*

DC Plate Voltage	1500	2000	2500 Volts
DC Plate Current	520	525	450 mA
Total Bias Voltage	—370	—500	—550 Volts
Fixed Bias Voltage	—160	—260	—440 Volts
Grid Resistor	2800	3000	2000 Ohms
DC Grid Current	75	80	55 mA
Peak RF Grid Input Voltage	545	695	720 Volts
Driving Power	41	55	40 Watts
Grid Dissipation	13	15	10 Watts
Plate Power Input	780	1050	1125 Watts
Plate Dissipation	200	200	200 Watts
Power Output	580	850	925 Watts

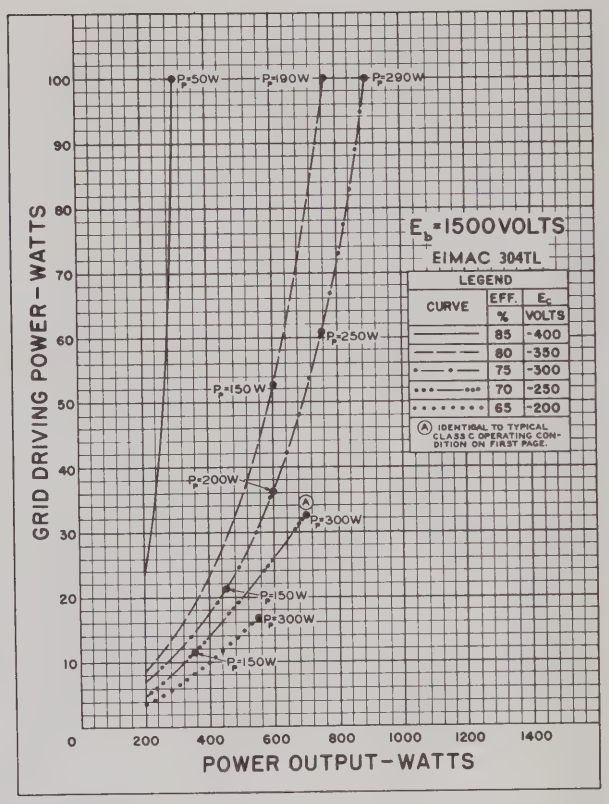
*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class C amplifier. The output figures do not allow for circuit losses.

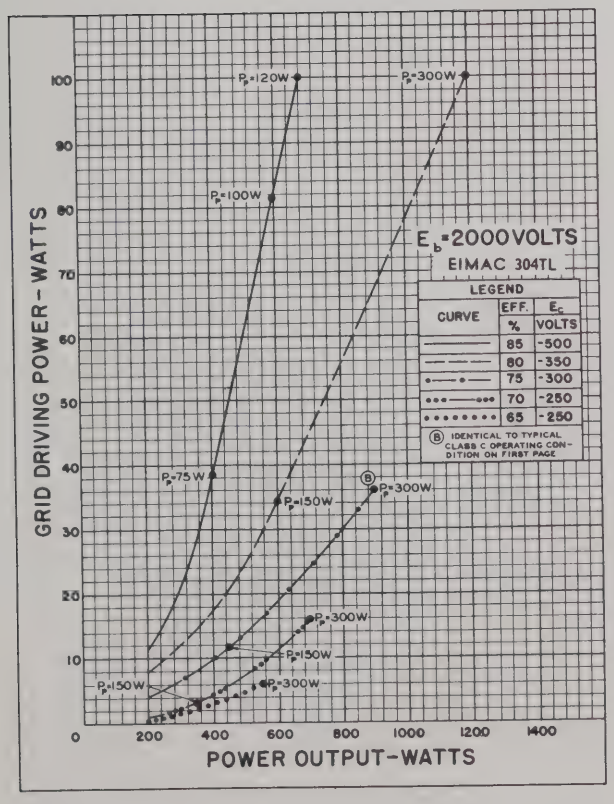


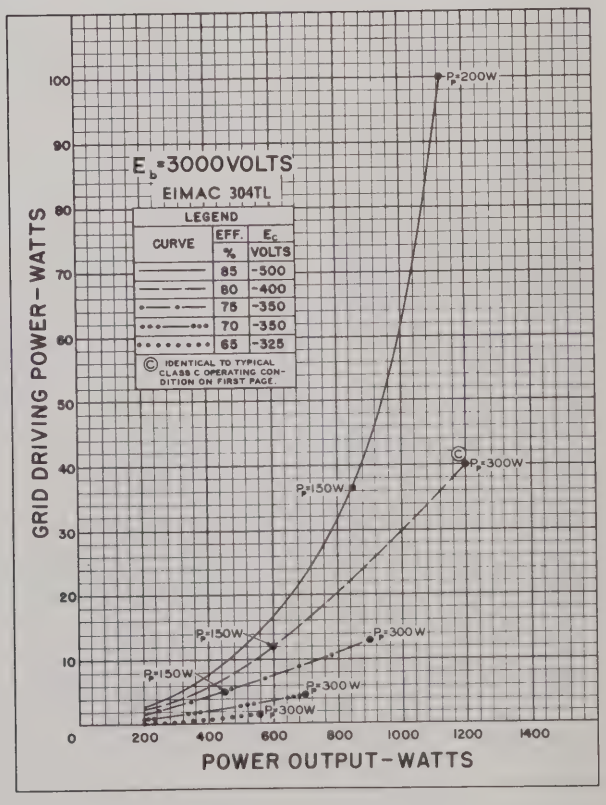
DRIVING POWER vs. POWER OUTPUT

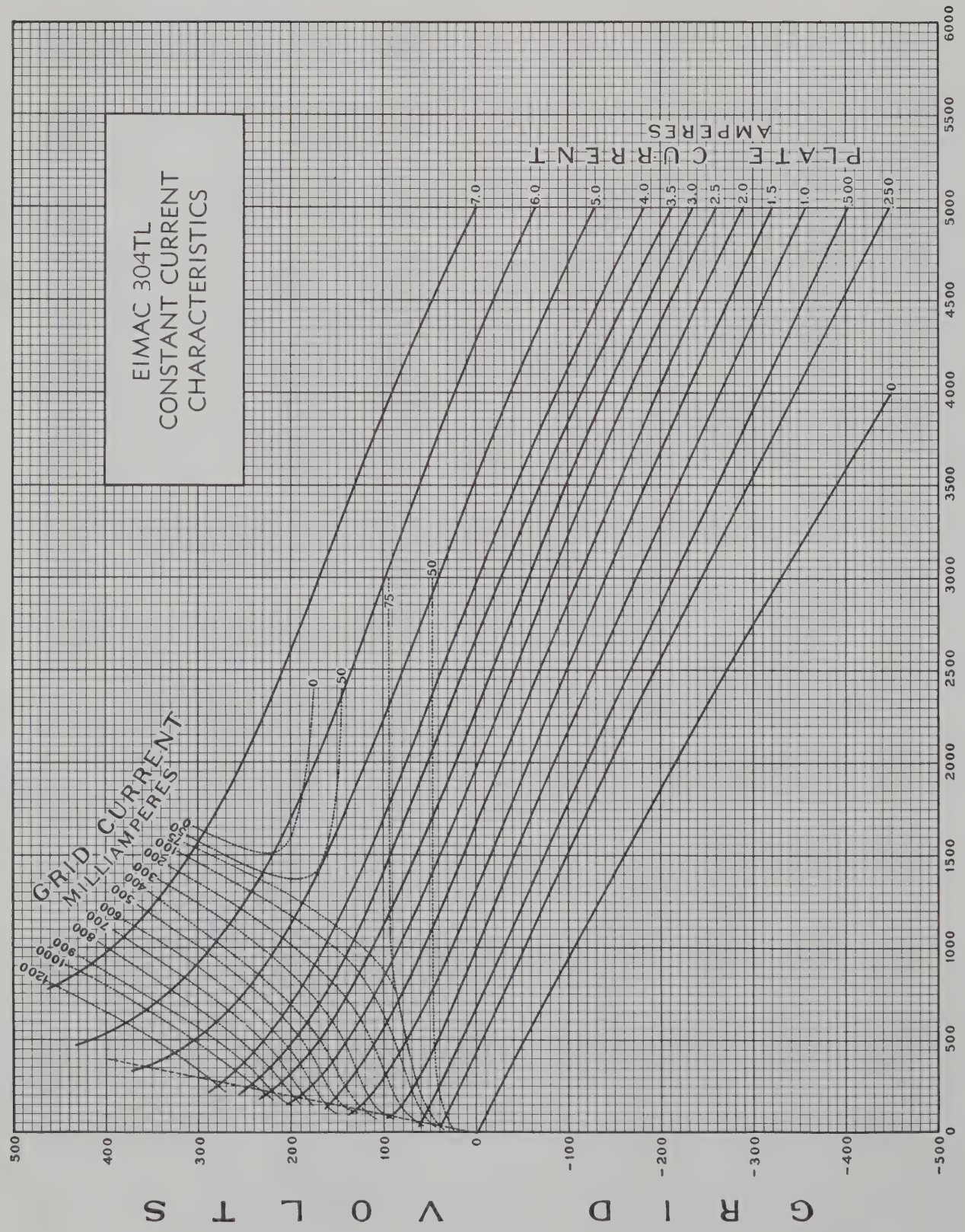
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.








EIMAC 304TL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
AMPERES
7.0
6.0
5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.500
.250
0
GRID CURRENT
MILLIAMPERES
0
50
75
50
0
25
50
100
200
300
400
500
600
700
800
900
1000
1200
PLATE VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
GRID VOLTS
500
400
300
200
100
0
-100
-200
-300
-400
-500

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

7211

HIGH-MU UHF TRIODE

The EIMAC 7211 is a ceramic-and-metal planar triode designed for use as a power amplifier, oscillator, or frequency multiplier in applications requiring greater power output than can be realized from the 7289/3CX100A5. Although similar in appearance, the EIMAC 7211 incorporates a significantly improved and enlarged cathode which increases the cathode current capability to a maximum of 190 mA at frequencies to 2500 MHz.

Exacting dimensional tolerances inherent in the manufacturing processes provide the EIMAC 7211 with the maximum mechanical uniformity. Critical electrical testing results in increased reliability and a minimum variation in electrical characteristics.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-coated, Unipotential				
Heating Time	60			sec
Heater:				
Voltage		6.3		volts
Current	1.2		1.4	amps
Amplification Factor		80		

Direct Interelectrode Capacitances	Min.	Max.	
Grid-Cathode	7.0	9.0	pF
Grid-Plate	2.1	2.4	pF
Plate-Cathode		0.06	pF
Frequency for Maximum Ratings		2500	MHz

MECHANICAL

Terminals	Graduated Cylindrical Surfaces
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Cooling	Conduction and Forced Air
Maximum Overall Dimensions:	
Length	2.701 inches
Diameter	1.264 inches
Net Weight	2.5 ounces
Shipping Weight	7.0 ounces

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	1000 VOLTS
DC CATHODE CURRENT	0.190 AMP
DC GRID VOLTAGE	—150 VOLTS
DC GRID CURRENT	0.045 AMP
INSTANTANEOUS PEAK POSITIVE GRID VOLTAGE	30 VOLTS
INSTANTANEOUS PEAK NEGATIVE GRID VOLTAGE	—400 VOLTS
PLATE DISSIPATION	100 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION
Power Amplifier Grounded-Grid
(key-down conditions)

	500 MHz	2500 MHz	
DC Plate Voltage	900	900	Volts
DC Grid Voltage (approx.)	–30	–20	Volts
DC Plate Current	140	140	mA
DC Grid Current (approx.)	40	15	mA
Driving Power (approx.)	9	—	Watts
Useful Output Power	65	25	Watts

(Revised 6-1-67) © 1964, 1966, 1967 Varian

Printed in U.S.A.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	600 VOLTS
DC CATHODE CURRENT	0.190 AMP
DC GRID VOLTAGE	–150 VOLTS
DC GRID CURRENT	0.045 AMP
INSTANTANEOUS PEAK POSITIVE GRID VOLTAGE	30 VOLTS
INSTANTANEOUS PEAK NEGATIVE GRID VOLTAGE	–400 VOLTS
PLATE DISSIPATION	70 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION
500 MHz, Grounded-Grid, Carrier Conditions

DC Plate Voltage	600 Volts
DC Grid Voltage (approx.)	–20 Volts
DC Plate Current	100 mA
DC Grid Current (approx.)	35 mA
Driving Power (approx.)	8 Watts
Useful Carrier Power Output	25 Watts

GRID PULSED OSCILLATOR OR AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC GRID VOLTAGE	–150 VOLTS
PULSE PLATE CURRENT	5.0 AMPS
PULSE GRID CURRENT	2.5 AMPS
PULSE DURATION	6 μs
DUTY FACTOR	.0033
PLATE DISSIPATION	100 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION
(1100 MHz, 3μs pulse, .002 Duty)

DC Plate Voltage	2200 Volts
DC Grid Voltage	–45 Volts
Pulse Plate Current	2.1 Amps
Pulse Grid Current	.95 Amp
Pulse Drive Power	400 Watts
Pulse Power Output	2650 Watts

APPLICATION

MECHANICAL

Mounting — The 7211 may be operated in any position. It should be firmly held in place by spring-finger collets bearing on the terminal surfaces. In use the tube should seat against the underside of the anode-terminal flange which is on the plane of reference for longitudinal dimensions. In applications involving severe shock and vibration, the tube may be clamped in place by applying a suitable clamping device to the anode-terminal flange. It is recommended that no other portion of the tube be subjected to clamping forces.

Connections — The terminals are in the form of concentric cylinders of graduated diameters conveniently used with coaxial tuning devices. Spring-fingered collets should be used to make contact with the anode, grid, cathode and heater terminals. Adequate contact area and spring pressure should be provided to minimize heating and to prevent erratic circuit performance at the higher frequencies. Non-contacting or intermittently-contacting collet fingers will cause troublesome circuit behavior, especially at very-high and ultra-high frequencies. Electrode contact surfaces should be kept clean and free of oxide coatings.

Cooling — Sufficient cooling air must be provided for the anode and body seals to maintain operating temperatures below the rated maximum value of 250°C.

At sea level, with an inlet air temperature of 20°C (68°F), 12.5 cubic feet per minute of air flow is required to cool the anode at 100 watts plate dissipation when the air cowling as illustrated is used. Operation at higher altitudes or with higher inlet temperatures requires increased volumes of flow to obtain equivalent cooling. When using the anode cowling as illustrated here, it is necessary to provide additional facilities for seal cooling.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness, regardless of the coolant type, flow rate or coolant temperature. One method of measuring the surface temperatures is the use of temperature sensitive lacquer, such as "Tempilaq."

ELECTRICAL

Heater Operation — The rated heater voltage for the 7211 is 6.3 volts. The heater voltage for the 7211 should be maintained within plus or minus 5% of its intended value to minimize variations in circuit performance and to obtain maximum tube life.

At frequencies above approximately 1000 MHz, transit time effects begin to influence cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, driving power, and duty factor. If the conditions of operation result in appreciable cathode back-heating, it may be necessary

to start dynamic tube operation at normal heater voltage followed by a reduction of heater voltage to a lower value.

Cathode Operation — The oxide-coated unipotential cathode in this tube must be protected against excessively high emission currents. For all types of operation the maximum rated dc current is 190 milliamperes.

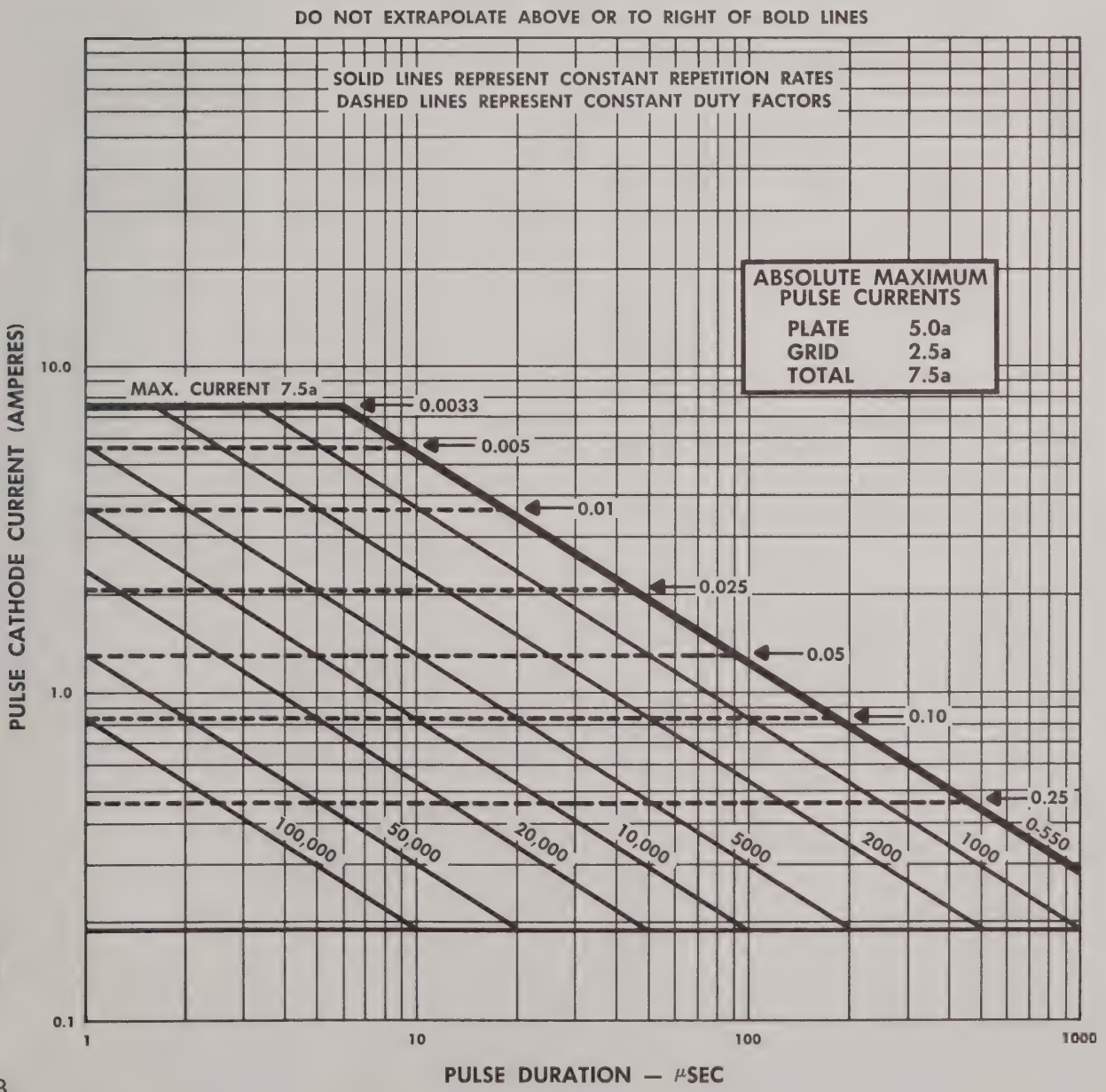
It is recommended that the rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied.

Control Grid Operation — Grid dissipation must not exceed the rated maximum 2.0 watts grid dissipation power. In pulse applications the instantaneous peak grid-to-cathode voltage must be limited to +250 to —750 volts.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

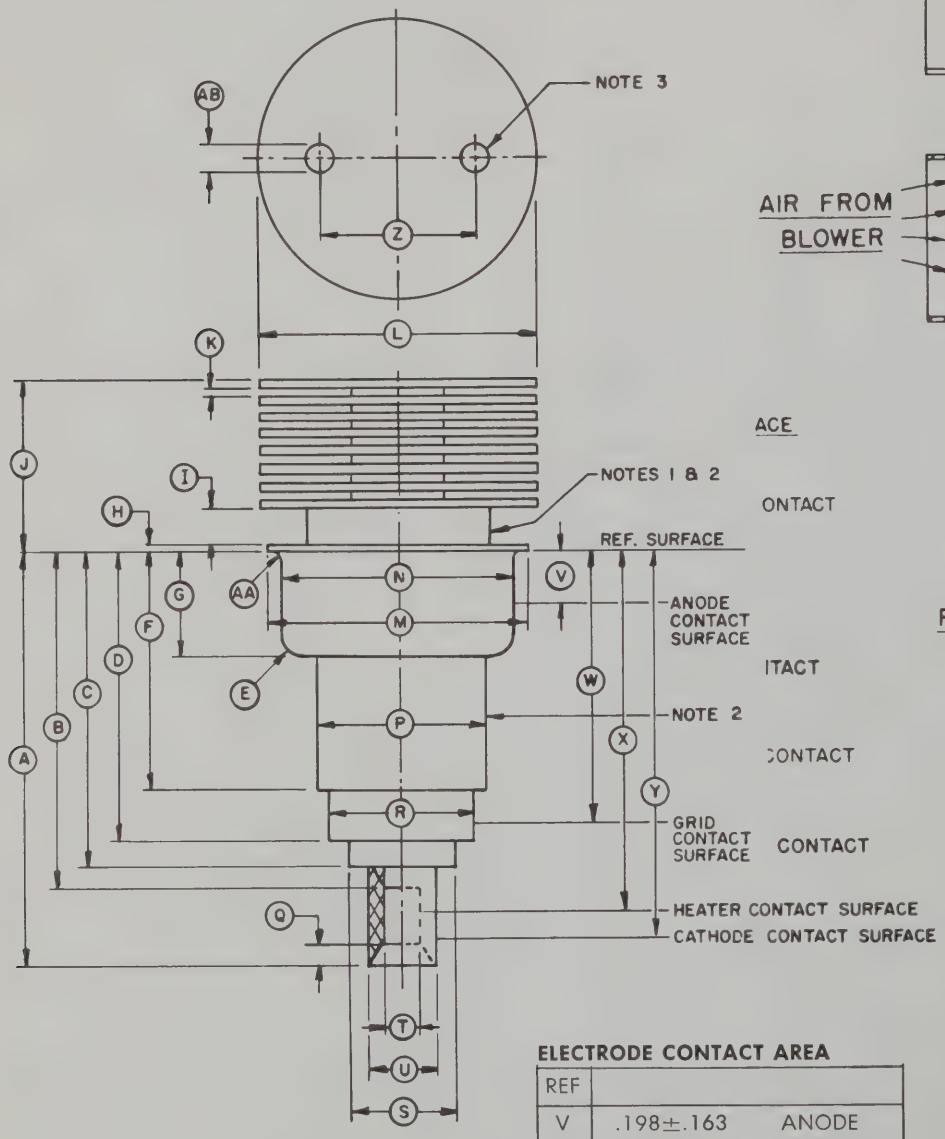
PULSE CATHODE VS. PULSE LENGTH

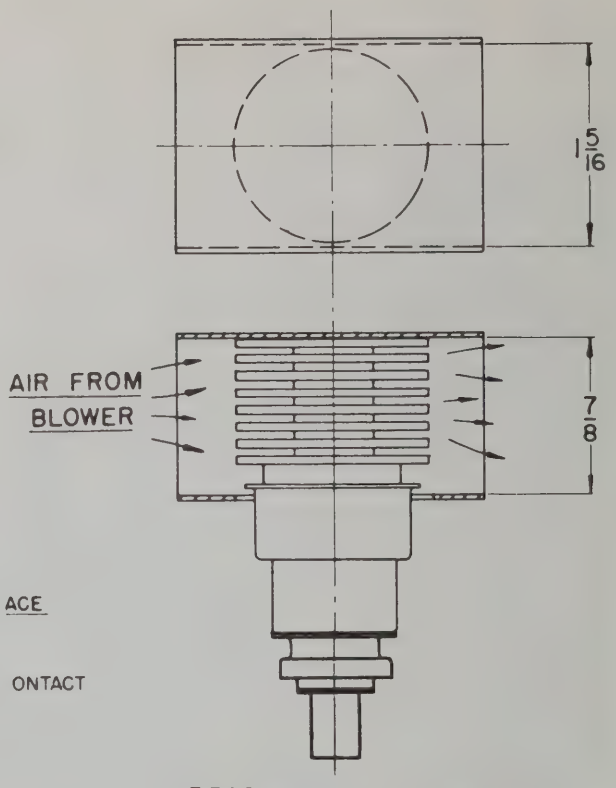
7211



NOTES:

1. MEASURE ANODE SHANK TEMPERATURE ON THIS SURFACE.
2. DO NOT CLAMP OR LOCATE ON THIS SURFACE.
3. HOLE PROVIDED FOR TUBE EXTRACTOR THROUGH TOP FIN ONLY.





RECOMMENDED COWLING FOR FORCED-AIR COOLING OF ANODE

ELECTRODE CONTACT AREA

REF		
V	.198±.163	ANODE
W	1.225±.040	GRID
X	1.631±.097	HEATER
Y	1.645±.170	CATHODE

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.815	1.875	
B		1.534	
C		1.475	
D	1.289	1.329	
E		.100	
F	.970	1.010	
G	.462	.477	
H		.040	
I	.125	.185	
J	.766	.826	
K	.025	.046	
L	1.234	1.264	
M	1.180	1.195	
N	1.025	1.035	
P	.772	792	
Q		086	
R	.655	.665	
S		.545	
T	213	.223	
U	.315	.325	
Z	.650	.850	
AA		.035	
AB	.105	.145	

NOTES:

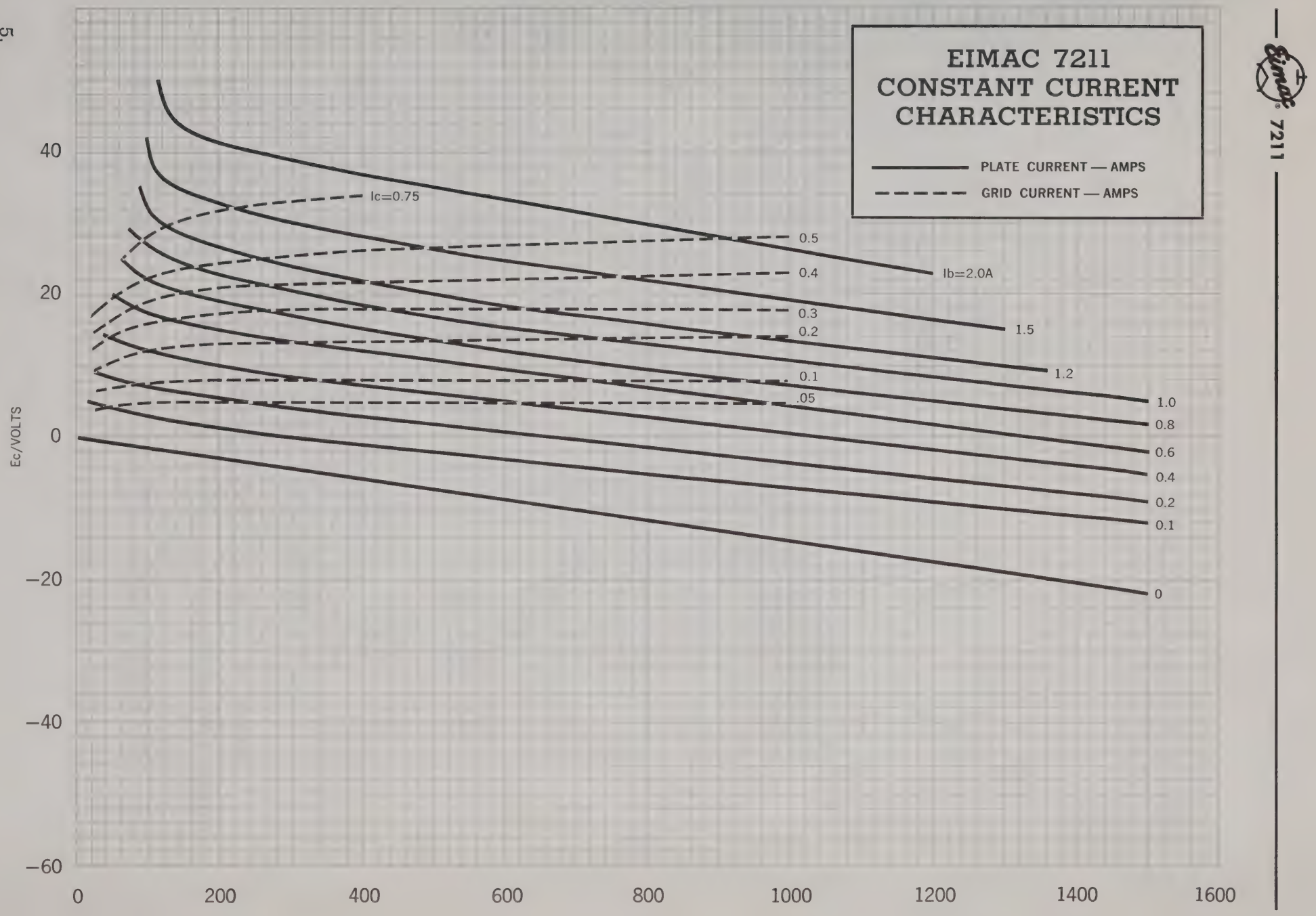
1. The total indicated runout of the anode contact surface and the grid contact surface with respect to the cathode contact surface shall not exceed .020.

2. The total indicated runout of the heater contact surface with respect to the cathode contact surface shall not exceed .012.

3.

PULSE CATHODE CURRENT (AMPERES)

5.



Eimac 7211

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4-125A

(4D21)
RADIAL-BEAM POWER TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 4-125A is a radial-beam power tetrode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate-dissipation rating of 125 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 120 MHz.

The low grid-plate capacitance of this tetrode together with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling is by radiation from the plate and by air circulation through the base and around the envelope.

The 4-125A in class-C rf service will deliver up to 375 watts plate power output with 1.2 watts nominal driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	6.5	amperes
Grid-Screen Amplification Factor (Average)	5.9	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.05	pF
Input	10.8	pF
Output	3.1	pF
Transconductance (I_b=50 mA, E_b=2500 V, E_{c2}=400 V)	2450	μmhos
Highest Frequency for Maximum Ratings	120	MHz

MECHANICAL

Base	5-pin metal shell
Basing	See outline drawing
Socket	E. F. Johnson Co. socket No. 122-275, National Co. No.HX-100, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-6
Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.1 inches
Net Weight	6.5 ounces
Shipping Weight	1.5 pounds

(Revised 6-1-67) © 1958, 1967 by Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down condition, 1 tube)

MAXIMUM RATINGS

DC Plate Voltage[1]	3000 volts
DC Screen Voltage	400 volts
DC Grid Voltage	−500 watts
DC Plate Current	225 mA
Plate Dissipation	125 watts
Screen Dissipation	20 watts
Grid Dissipation	5 watts

TYPICAL OPERATION

(Frequencies below 120 MHz)				
DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage	−100	−150	−150	volts
DC Plate Current	200	200	167	mA
DC Screen Current	50	40	30	mA
DC Grid Current	12	12	9	mA
Screen Dissipation	18	14	10.5	watts
Grid Dissipation	1.6	2	1.2	watts
Peak RF Grid Input Voltage (approx.)	230	320	280	volts
Driving Power (approx.)[3]	2.8	3.8	2.5	watts
Plate Power Input	400	500	500	watts
Plate Dissipation	125	125	125	watts
Plate Power Output	275	375	375	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_1

MAXIMUM RATINGS

DC Plate Voltage	3000 volts
DC Screen Voltage	600 volts
Max-Signal DC Plate Current, per Tube	225 mA
Plate Dissipation, per Tube	125 watts
Screen Dissipation, per Tube	20 watts

TYPICAL OPERATION

(Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1500	2000	2500	volts
DC Screen Voltage	600	600	600	volts
DC Grid Voltage[2]	−90	−94	−96	volts
Zero-Signal DC Plate Current	60	50	50	mA
Max-Signal DC Plate Current	222	240	232	mA
Zero-Signal DC Screen Current	−1.0	−0.5	−0.3	mA
Max-Signal DC Screen Current	17	6.4	8.5	mA
Effective Load, Plate-to-Plate	10,200	13,400	20,300	ohms
Peak, AF Grid Input Voltage (per tube)	90	94	96	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	87.5	125	125	watts
Max-Signal Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per ct.

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

DC Plate Voltage[1]	2500 volts
DC Screen Voltage	400 volts
DC Grid Voltage	−500 watts
DC Plate Current	200 mA
Plate Dissipation	85 watts
Screen Dissipation	20 watts
Grid Dissipation	5 watts

TYPICAL OPERATION

(Frequencies below 120 MHz)			
DC Plate Voltage	2000	2500	volts
DC Screen Voltage	350	350	volts
DC Grid Voltage	−220	−210	volts
DC Plate Current	150	152	mA
DC Screen Current	33	30	mA
DC Grid Current	10	9	mA
Screen Dissipation	11.5	10.5	watts
Grid Dissipation	1.6	1.4	watts
Peak AF Screen Voltage, 100% Modulation	210	210	volts
Peak RF Grid Input Voltage (approx.)	375	360	volts
Driving Power (approx.)[3]	3.8	3.3	watts
Plate Power Input	300	380	watts
Plate Dissipation	75	80	watts
Plate Power Output	225	300	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2

MAXIMUM RATINGS

DC Plate Voltage	300 volts
DC Screen Voltage	400 volts
Max-Signal DC Plate Current, per Tube	225 mA
Plate Dissipation, per Tube	125 watts
Screen Dissipation, per Tube	20 watts

TYPICAL OPERATION

(Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1500	2000	2500	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage	−41	−45	−43	volts
Zero-Signal DC Plate Current	87	72	93	mA
Max-Signal DC Plate Current	400	300	260	mA
Zero-Signal DC Screen Current	0	0	0	mA
Max-Signal DC Screen Current	34	5	6	mA
Effective Load, Plate-to-Plate	7200	13,600	22,200	ohms
Peak AF Grid Input Voltage (per tube)	141	105	89	volts
Max-Signal Avg. Driving Power (approx.)	2.5	1.4	1	watts
Max-Signal Peak Driving Power	5.2	3.1	2.4	watts
Max-Signal Plate Dissipation (per tube)	125	125	122	watts
Max-Signal Plate Power Output	350	350	400	watts
Total Harmonic Distortion	2.5	1	2.2	per ct.

(1) Above 120 MHz the maximum plate voltage rating depends upon frequency. See page 4.

(2) The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

(3) Driving power increases above 70 MHz. See page 4.

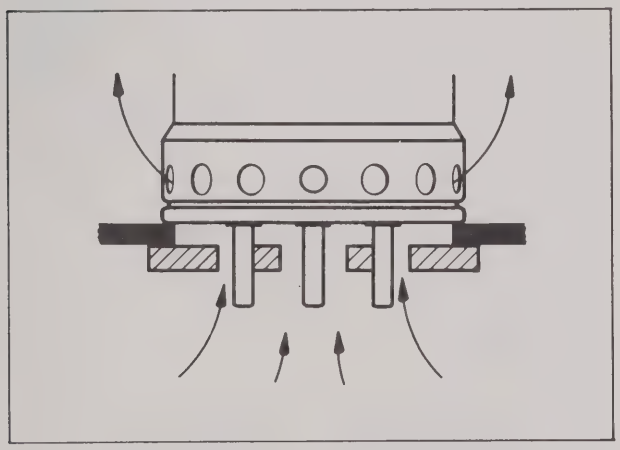
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION" POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 4-125A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-125A mounting providing base cooling, shielding and isolation of output and input compartments.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 MHz. At frequencies above 30 MHz, radio frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 MHz, however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperatures below this maximum at frequencies below 30 MHz, provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage— For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage— Dc bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage— The dc screen voltage for the 4-125A should not exceed 400 volts, except for class-AB audio operation.

Plate Voltage— The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 MHz. The maximum permissible plate voltage is less than 3000 volts above 120 MHz, as shown by the graph on page 5.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to about 30 MHz if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted as shown in the mounting diagram on page three provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feed-back at frequencies above 100 MHz is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest possible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 MHz ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below about 30 MHz.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 5. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 MHz. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 MHz.

Conventional capacitance-shortened quarter-wave linear grid tank circuits having a calculated Z_0 of 160 ohms or less may be used with the 4-125A up to 175 MHz. Above 175 MHz linear grid tank circuits employing a "capacitor"-type shortening bar, as illustrated in the diagram below, may be used. The capacitor, C_1, may consist of two silver-plated brass plates one inch square with a piece of .010 inch mica or polystyrene as insulation.

Class-C AM Telephony—The rf circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating dc screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate rf by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 2.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio— Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

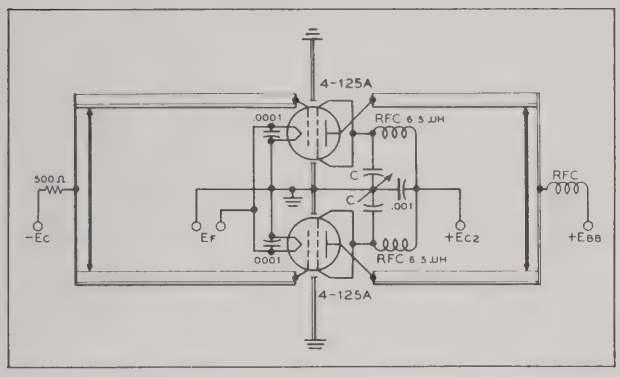
When type 4-125A tubes are used as class-AB_1, or class-AB_2 audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation," the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order

of regulation will serve. The driver plate supply makes a convenient source of screen voltage under these conditions.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the dc resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.

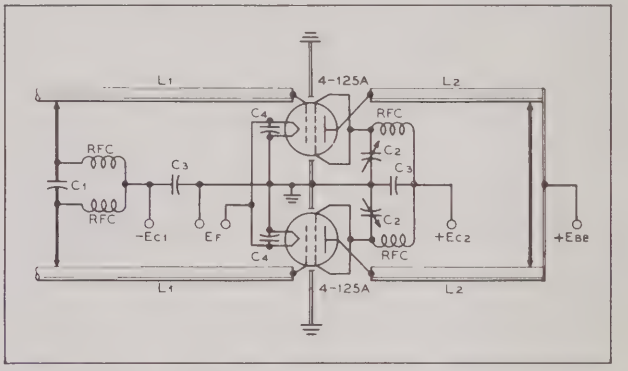
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



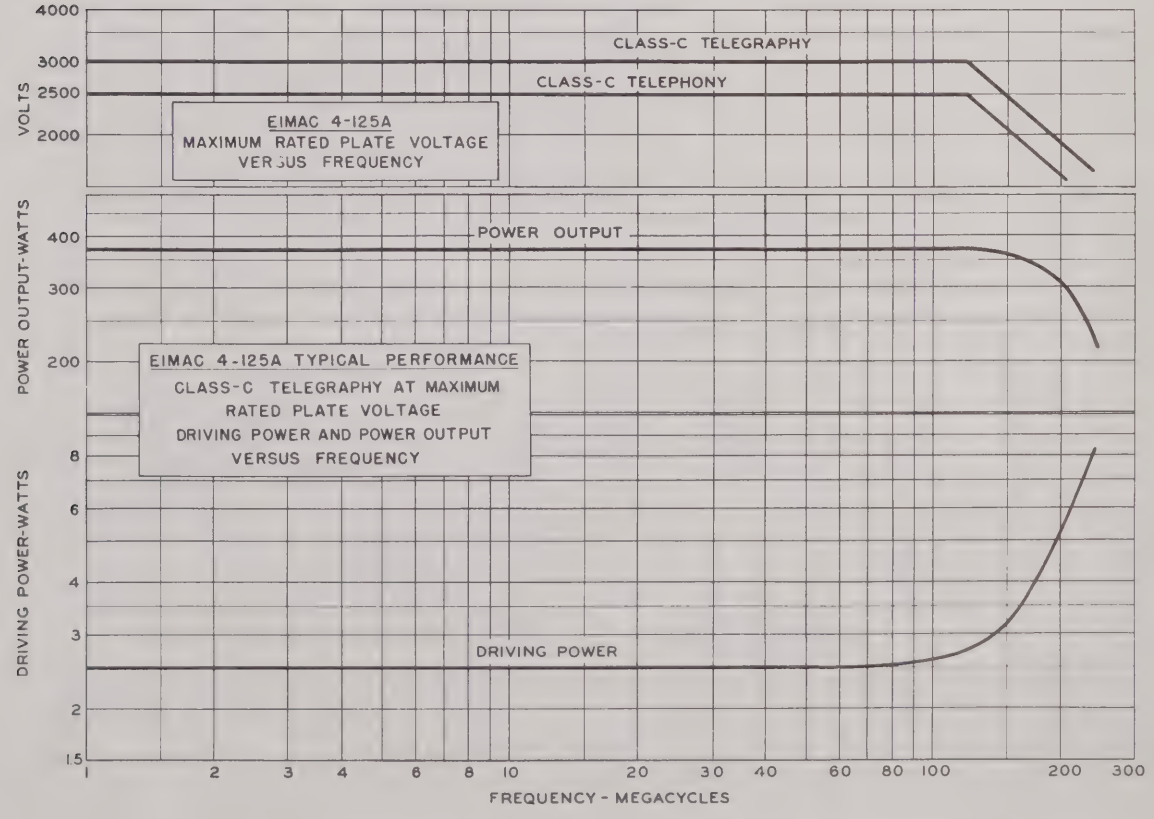
Screen-tuning neutralization circuit for use above 100 Mc.
C is a small split-stator capacitor.

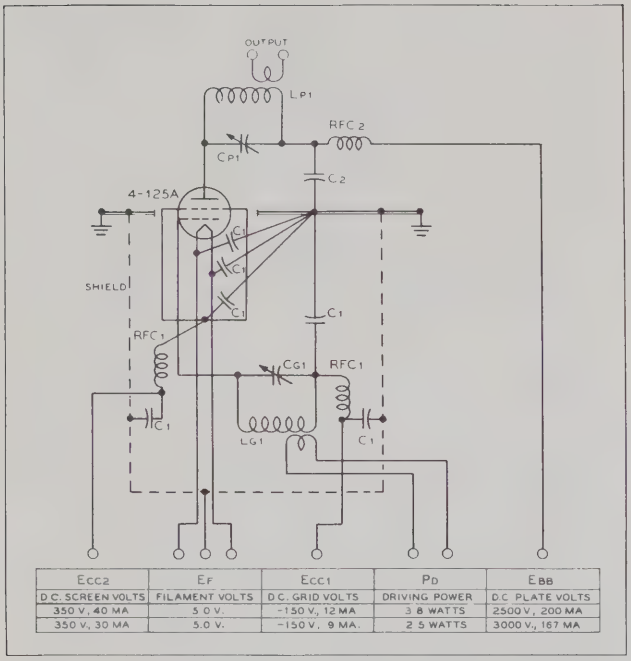
$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\ ,\ approx.$$



Typical circuit arrangement useful for frequencies above 175 Mc.

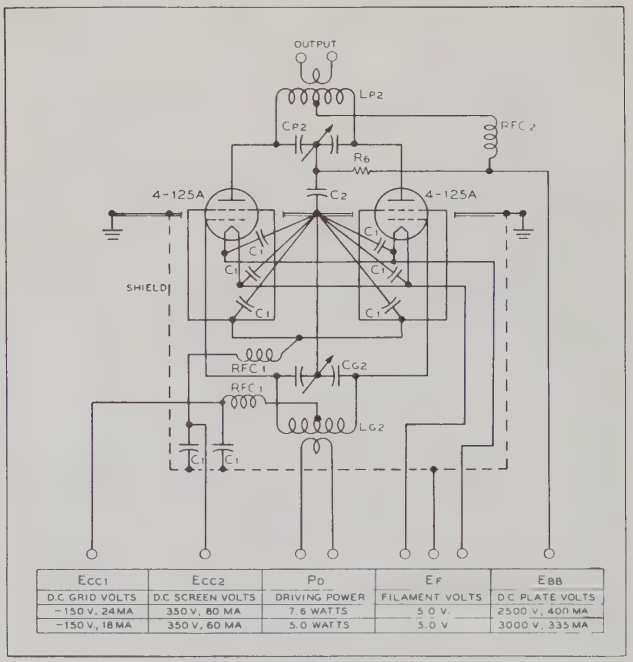
C_1—See above.
C_2—Neutralizing capacitor.
C_3—.001 μfd.
C_4—100 $\mu\mu$fd.
L_1—3/8" dia. copper spaced 1" center-to-center, 6" long.
L_2—7/8" dia. brass, silver plated, spaced 1 1/2" center-to-center, 14" long.





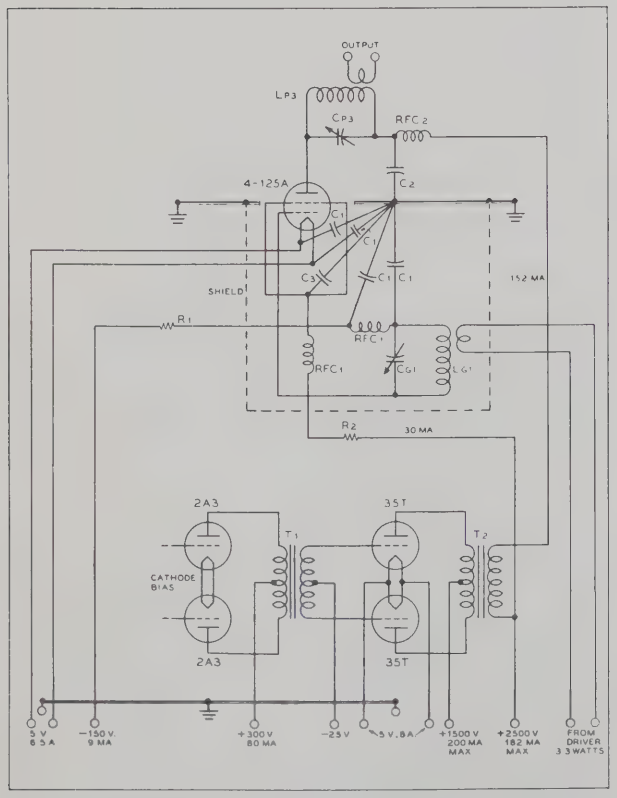
Ecc2	Ef	Ecc1	Pd	Ebb
D.C. SCREEN VOLTS	FILAMENT VOLTS	D.C. GRID VOLTS	DRIVING POWER	D.C. PLATE VOLTS
350 V., 40 MA	5.0 V.	−150 V., 12 MA	3.8 WATTS	2500 V., 200 MA
350 V., 30 MA	5.0 V.	−150 V., 9 MA.	2.5 WATTS	3000 V., 167 MA

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 500 watts input.

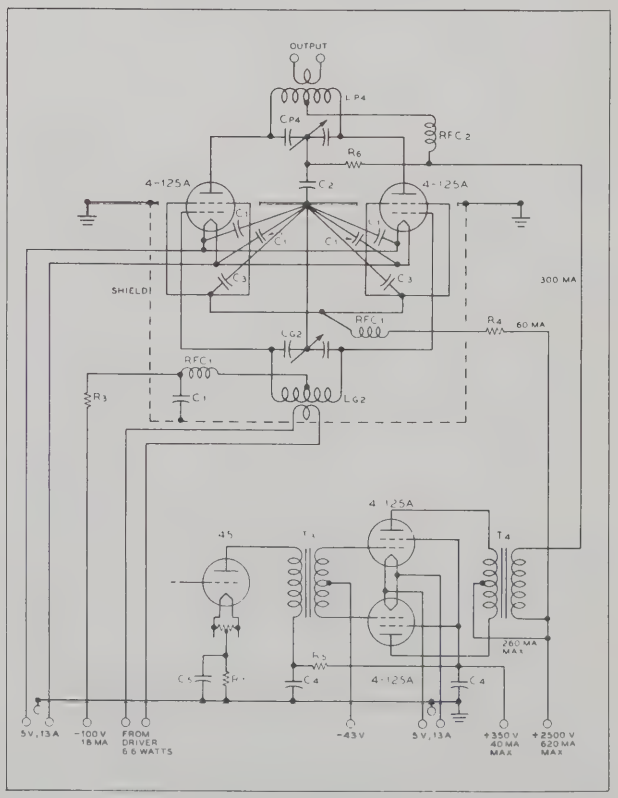


Ecc1	Ecc2	Pd	Ef	Ebb
D.C. GRID VOLTS	D.C. SCREEN VOLTS	DRIVING POWER	FILAMENT VOLTS	D.C. PLATE VOLTS
−150 V., 24 MA	350 V., 80 MA	7.6 WATTS	5.0 V.	2500 V., 400 MA
−150 V., 18 MA	350 V., 60 MA	5.0 WATTS	5.0 V.	3000 V., 335 MA

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 380 watts plate input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 750 watts plate input.

See opposite page for list of components.

COMPONENTS FOR TYPICAL CIRCUITS

(Diagrams, Page 6)

L_{p1} - C_{p1} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p2} - C_{p2} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p3} - C_{p3} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{p4} - C_{p4} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating freqency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — 16-ufd., 450-v. electrolytic

C_5 — 10-ufd., 25-v. electrolytic

R_1 — 7000 ohms, 5 watts

R_2 — 70,000 ohms, 100 watts

R_3 — 3500 ohms, 5 watts

R_4 — 35,000 ohms, 200 watts

R_5 — 560 ohms, 1 watt

R_6 — 25,000 ohms, 2 watts

R_7 — 1500 ohms, 5 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

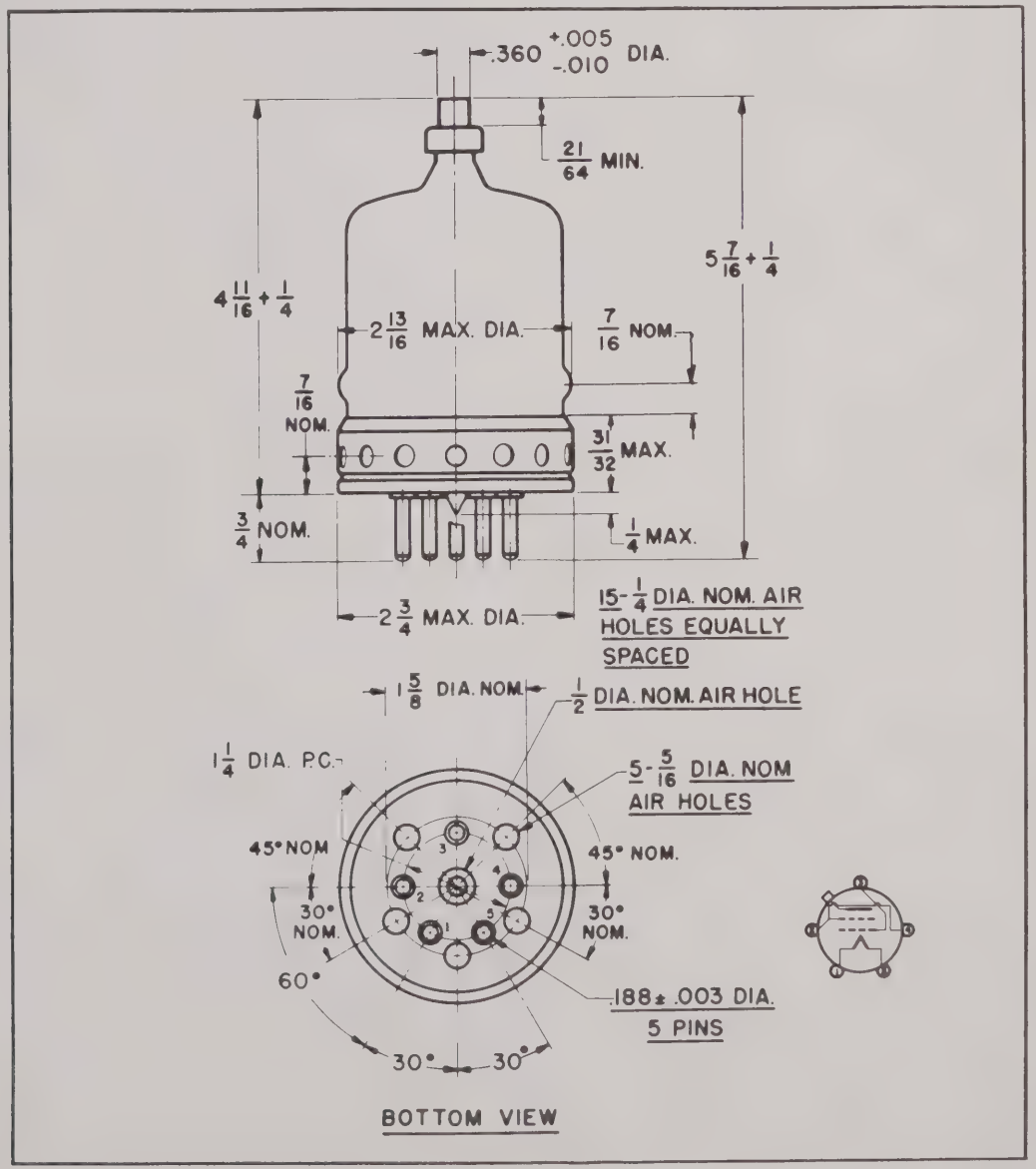
RFC_2 — 1-mhy., 500-ma. r-f choke

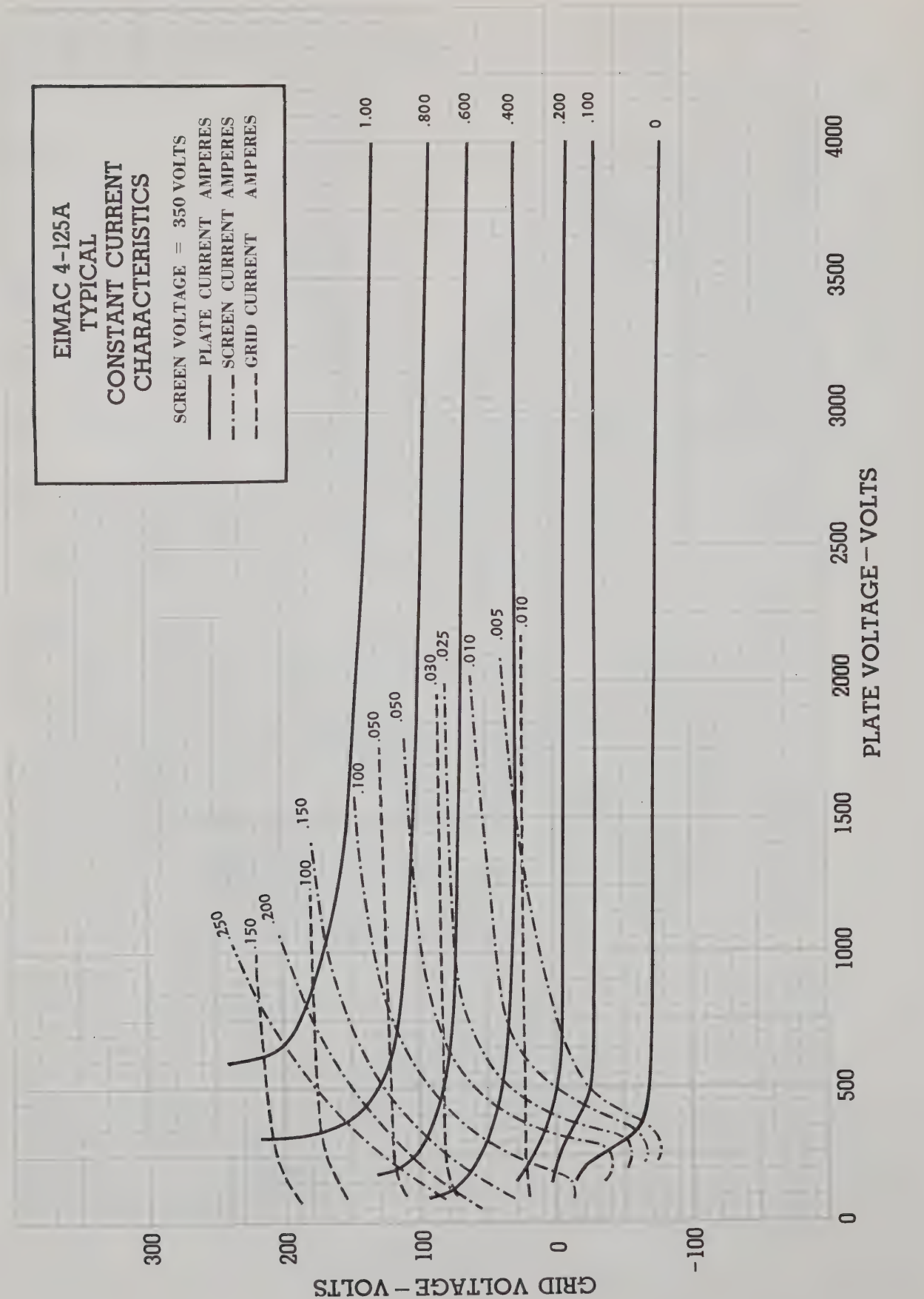
T_1 — 10-watt driver transformer; ratio pri. to 1/2 sec. approx. 2:1.

T_2 — 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16,200 ohms, sec. impedance = 16,500 ohms.

T_3 — 5-watt driver transformer; ratio pri. to 1/2 sec. approx. 1.1:1.

T_4 — 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22,200 ohms, sec. impedance = 8300 ohms.




EIMAC 4-125A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 350 VOLTS
PLATE CURRENT AMPERES
SCREEN CURRENT AMPERES
GRID CURRENT AMPERES
1.00
.800
.600
.400
.200
.100
0
.250
.150
.200
.100
.150
.100
.050
.050
.030
.025
.010
.005
.010
300
200
100
0
-100
GRID VOLTAGE – VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
PLATE VOLTAGE – VOLTS

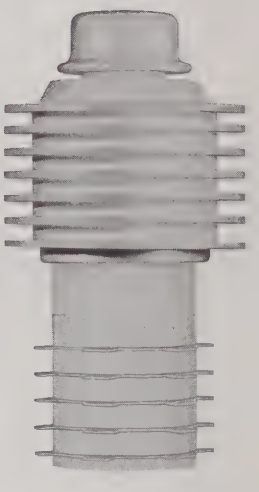
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CX125C
4CX125F

RADIAL-BEAM POWER TETRODES

The EIMAC 4CX125C and 4CX125F are horizontally-finned versions of the 4CX300A. These tubes possess the same rugged internal features of the 4CX300A and are quite free of mechanical noise under severe shock and vibration conditions.

The horizontal fins used on these tubes result in a lighter and smaller tube than the 4CX300A. Transverse cooling air-flow is required to attain the 125 watt nominal plate dissipation rating.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-heater Potential			± 150	volts
Heater:	Voltage: 4CX125C		6.0		volts
	4CX125F		26.5		volts
	Current: 4CX125C	2.6		3.1	amperes
	4CX125F	0.6		0.7	amperes
Amplification Factor (Grid–Screen)		4.0		5.6	
Transconductance (I_b = 200 Ma)			12,000		umhos
Frequency for Maximum Ratings				500	MHz

Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	25.0	33.0	pF
Output	3.5	4.5	pF
Feedback		0.06	pF

MECHANICAL

Base	Special, breechblock, terminal surfaces
Socket	EIMAC SK-700 series
Maximum Operating Temperatures:	
Anode Core	250° C
Ceramic-to-Metal Seals	250° C
Operating Position	Any
Cooling	Forced air
Net Weight	3.5 ounces
Shipping Weight (Approximate)	1 pound

MAXIMUM RATINGS

	Class–C Plate Mod	Class–C Teleg or FM	Class–AB Audio or SSB	
DC Plate Voltage	1500	2000	2000	volts
DC Screen Voltage	300	300	400	volts
DC Grid Voltage	−250	−250	...	volts
DC Plate Current	200	250	250	ma
Plate Dissipation	83	125	125	watts
Screen Dissipation	12	12	12	watts
Grid Dissipation	2	2	2	watts

Note: See 4CX300A data sheet for characteristic curves and typical operating conditions.

TYPICAL OPERATION

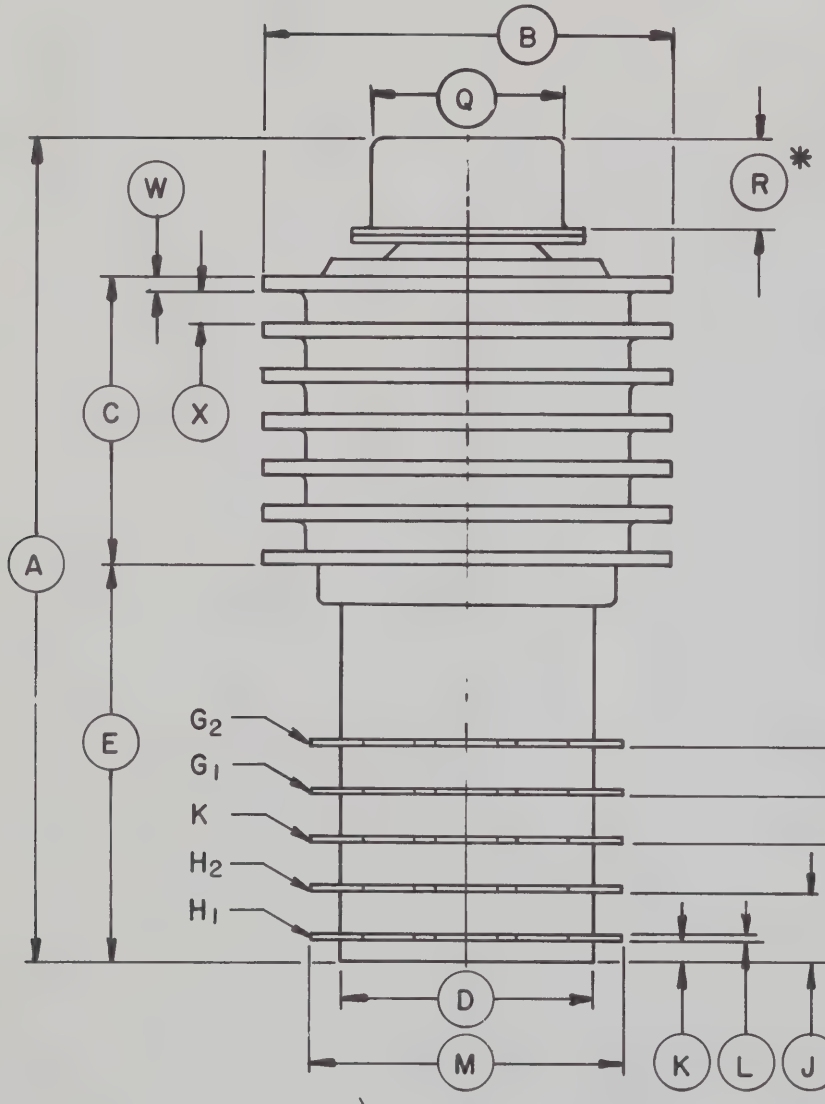
RF Amplifier (excluding circuit losses)	DC Plate Voltage (Volts)	Driving Power (Watts)	Input Power (Watts)	Output Power (Watts)
Class–C Telegraphy or FM Telephony	2000	3.0	500	390
Plate–Modulated Telephony (Carrier)	1500	2.0	300	235
Class–AB_1 Linear Amplifier	2000	0	315	205

(Revised 6-1-67) © 1963, 1967 by Varian

Printed in U.S.A.

APPLICATION

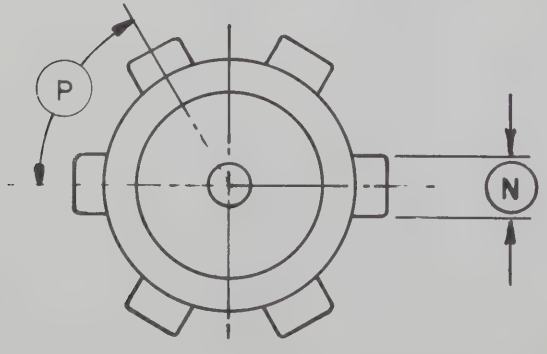
Cooling: The 4CX125C and 4CX125F are intended for use where transverse cooling air is desired. With the anode cooler installed in a duct of 1″ x 1½″ cross section, approximately 8 cfm of air is required to maintain seal temperatures below 250° C. This presumes sea level operation with an ambient temperature of 25 ° or less. Sufficient air must be circulated around the base terminals to maintain the rated seal temperatures.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.300	2.500	
B	1.240DIA	1.265DIA.	
C	.710	.790	
D	.740DIA	.770DIA	
E	1.133	1.195	
F	.602	.642	
G	.470	.500	
H	.329	.359	
J	.193	.213	
K	.050	.072	
L	.010	.020	
M	.936DIA.	.956DIA.	
N	.170	.185	
P			60°
Q	.559DIA.	.573DIA.	
R	.240	.280	
W			.040
X	.060	.090	

NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.



NOTES:

1. DIMENSIONS IN INCHES.
2. (*) CONTACT SURFACE

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8168
4CX1000A
CERAMIC POWER TETRODE

The EIMAC 8168/4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1630 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3260 watts of audio power.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		μmhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	pF
Output	11		13	pF
Feedback			0.022	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	pF
Output	11		13	pF
Feedback			0.004	pF
Frequency for Maximum Ratings			110	MHz

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Any
Maximum Over-all Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB or B
(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current*	890	885	875 mA
Two-Tone Average DC Plate Current	645	650	635 mA
Zero-Signal DC Screen Current*	8	6	5 mA
Single-Tone DC Screen Current*	35	35	35 mA
Two-Tone Average DC Screen Current*	10	8	8 mA
Plate Output Power	930	1300	1630 watts

*Approximate values.
[1]Adjust grid bias to obtain zero-signal plate current.

(Revised 6-1-67) © 1963, 1966, 1967 by Varian

Printed in U.S.A.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate	2040	2850	3680	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling — Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.
At higher altitudes and at VHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude*.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

The 4CX1000A is tested for vibration (noise) from 10 Hz to 500 Hz. Vibration level is 10 G units peak 28 Hz to 500 Hz. Below 28 Hz vibration double amplitude is .25 inch.

The 4CX1000A is tested for shock, 50 G, 11 ms, three axes, after which the tube must be within specification for grid bias voltage and gas current.

ELECTRICAL

Heater — The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation — The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five-milliamperes as read on a five-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and

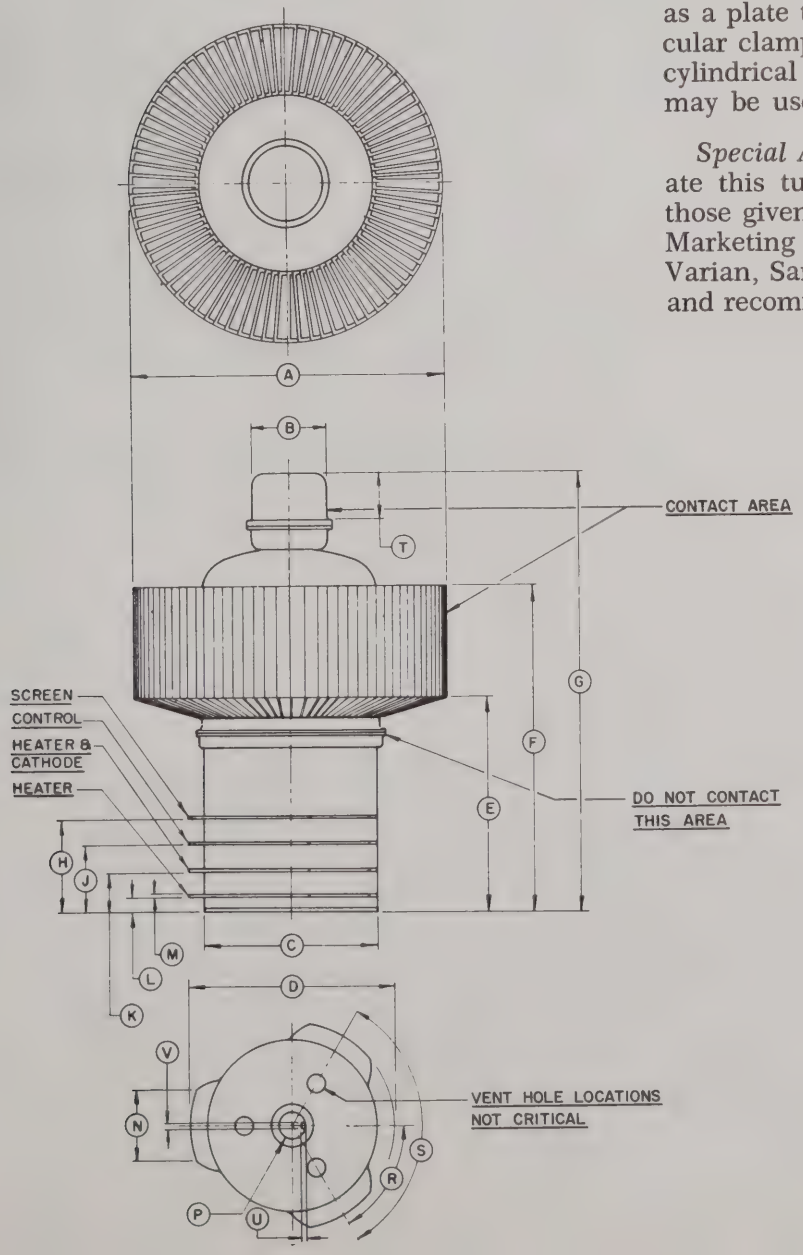
the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

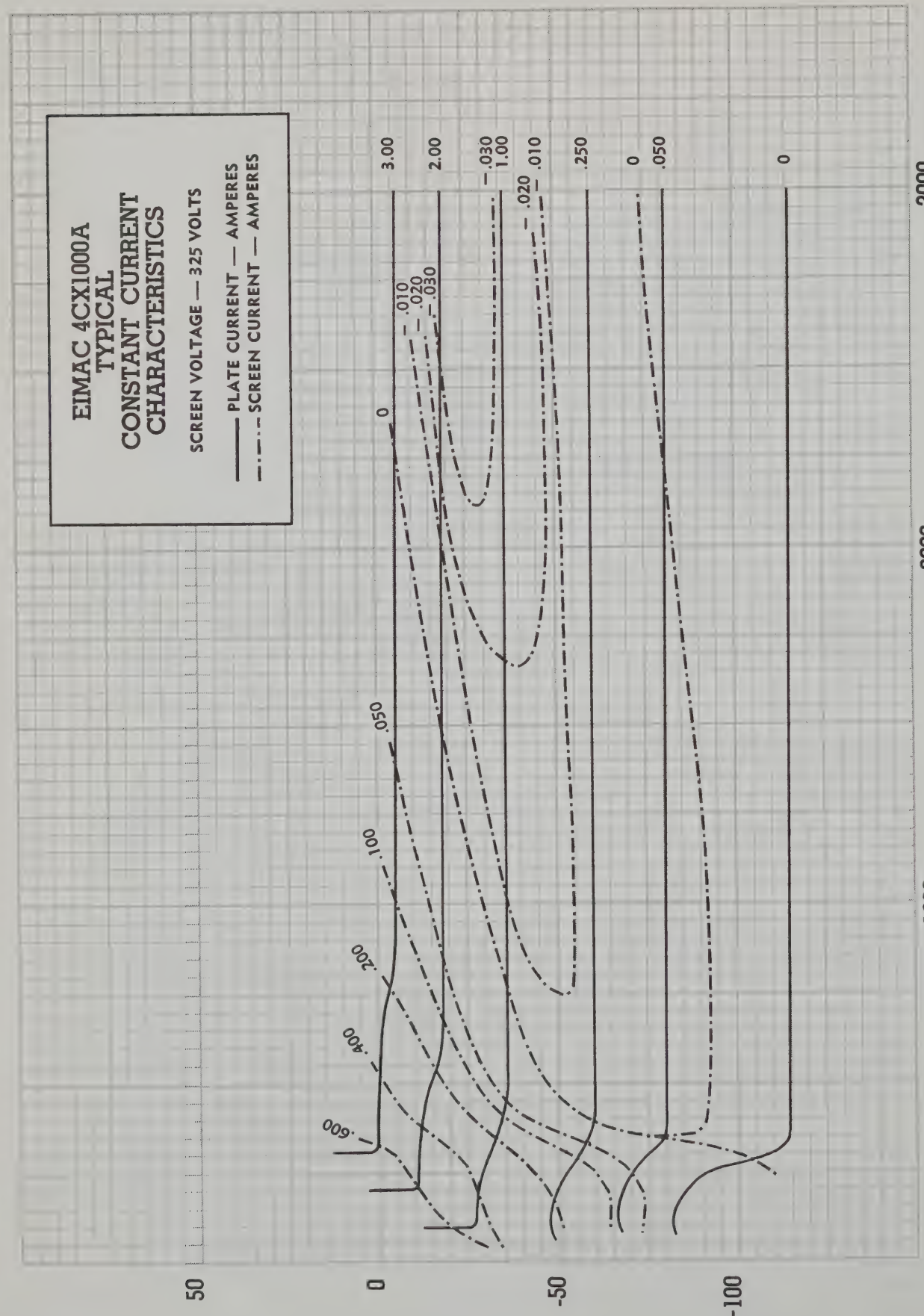
Plate Operation — The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, EIMAC Division of Varian, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.


EIMAC 4CX1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
3.00
2.00
1.00
.250
.050
0
.030
.020
.010
.600
.400
.200
.100
.050
0
50
0
-50
-100
1000
2000
3000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-406
SK-416
SK-426

AIR-SYSTEM CHIMNEYS



The SK-406, SK-416, and SK-426 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat-radiating connector.

MATERIALS

The SK-406, SK-416, and SK-426, Air-System Chimneys are made of sturdy, heat resistant Pyrex glass. The bottom edge is flat for a tight seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

These chimneys are designed for installation above the chassis or plenum that holds the companion Air-System Socket. The four spring clips supplied with the SK-400 (eight clips are supplied with the SK-410) socket also act as retaining clips for the chimney. After the socket and spring clips are installed, the chimney is pressed down over the spring clips.

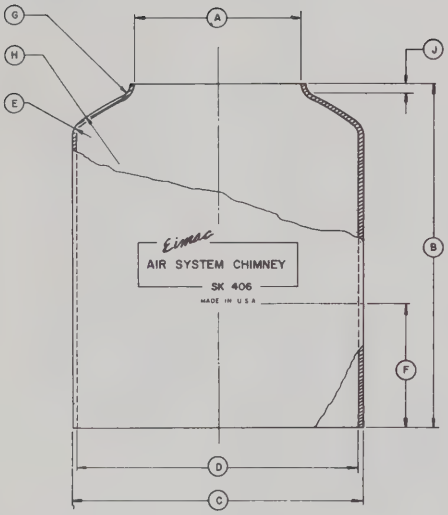
CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-406	4-125A 4-250A 4-400A 4PR125A 4PR400A	SK-400 SK-410
SK-416	3-400Z	
SK-426	5-500A	

Net Weight - - - - - - - - - - - - - - - - SK-406 — 8 ounces
SK-416 — 7 ounces
SK-426 — 8 ounces

(Revised 6-1-67) © 1963, 1965, 1967 by Varian

Printed in U.S.A.

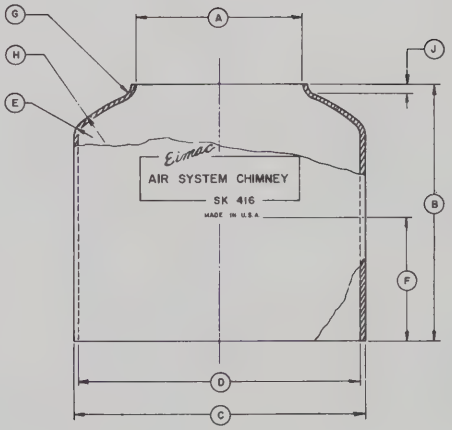


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.312	2.438	
B	4.813	5.000	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.625	1.875	
G		.188	
H			3.250
J		.188	.125

SK-406

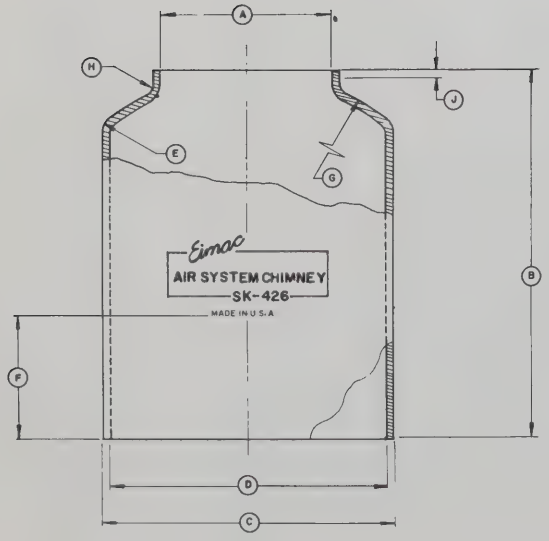


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN	MAX	NOM
A	2.312	2.438	
B	4.000	4.188	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.187	1.312	
G		.188	
H			3.250
J		.188	.125

SK-416



DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.312	2.438	
B	5.063	5.250	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.625	1.875	
G			3.250
H			.188
J			.125

SK-426

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-890B
AIR-SYSTEM SOCKET GROUNDED CATHODE TERMINALS
SK-806
AIR CHIMNEY

The EIMAC SK-890B is one of the air-system sockets recommended for use with the EIMAC 4CX1000A or 4CW2000A tetrodes. The SK-890B is especially designed for use at frequencies where series screen neutralization is employed and is so constructed that the screen-grid can be series tuned to ground through the screen by-pass capacitor. A companion SK-806 Air Chimney is also available and is recommended for use with the socket when the air-cooled 4CX1000A is to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-890B is humidity and salt-spray resistant.

The SK-890B is an improved version of the SK-890 and directly replaces the SK-890 in any equipment. The SK-890B features a stronger, one-piece base and improved contact tabs.

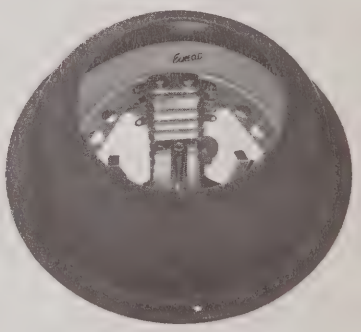


SK-890B

BASE CONNECTIONS

The SK-890B socket consists of three sets of spring-finger contact tabs for each tube electrode (to assure low-inductance contact), a center guide pin to facilitate tube installation, and an integral screen by-pass capacitor. The terminals are shown on the outline drawing.

When this socket is mounted on a grounded chassis, the cathode and one side of the heater will be automatically grounded. A grounding terminal is provided and may be used for positive connection if desired.



SK-890B WITH CHIMNEY

SCREEN-GRID BY-PASS CAPACITOR

This capacitor utilizes Mylar film as a dielectric and is encapsulated in silicone resin. Its capacitance is 1500 pF ±20 percent and it is rated at 400 dc working volts. The socket is so orientated that the three sets of spring finger contacts which connect to the screen-grid tabs of the tube are not connected to the upper, ungrounded side of the screen-grid capacitor. A series of six holes are provided to the upper capacitor deck to allow the installation of the screen neutralizing device; this device is connected between each of the solder terminals provided in the screen spring finger contacts and the upper capacitor deck. The lower capacitor deck is connected directly to the socket body.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are a one-piece, nickel-plated die-casting. All contacts are formed of a non-ferrous alloy, heat-treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-890B Air-System Socket is designed for under-chassis mounting and requires a 5-1/16 inch hole through the chassis deck. The socket is held in place by the three toe clamps provided. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-806 Air Chimney is moulded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-890B when the air-cooled 4CX1000A is to be socketed.

SK-890B

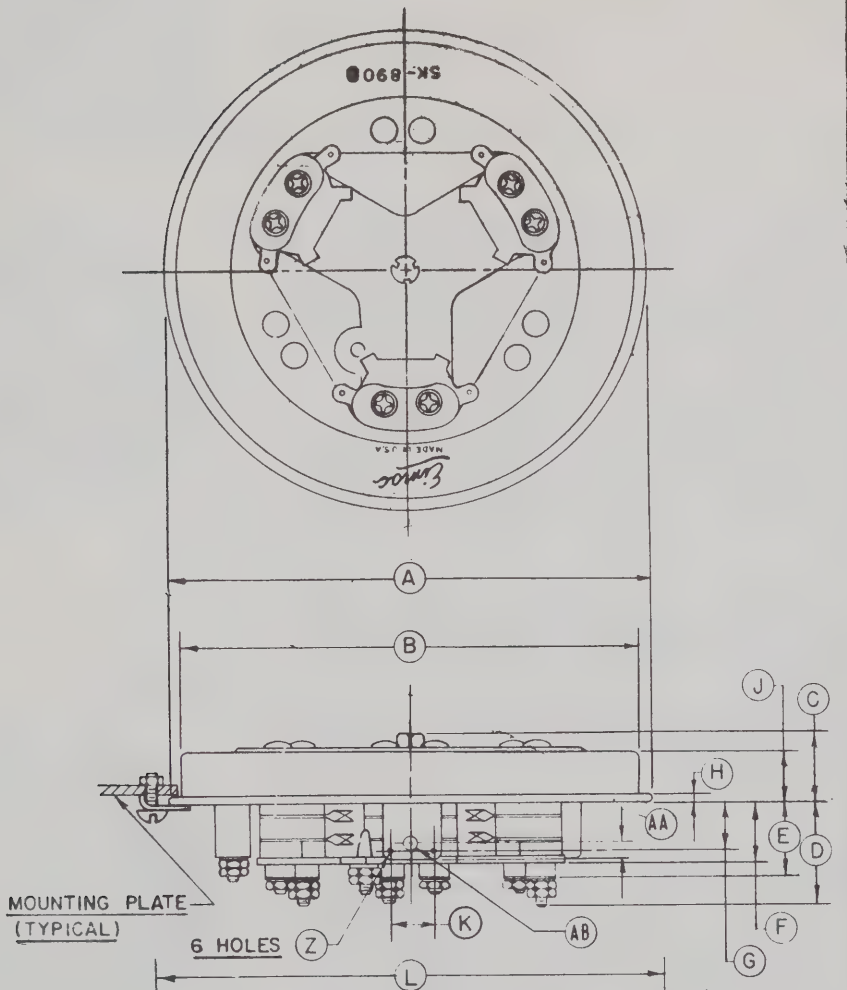
Net Weight	18 ounces

SK-806

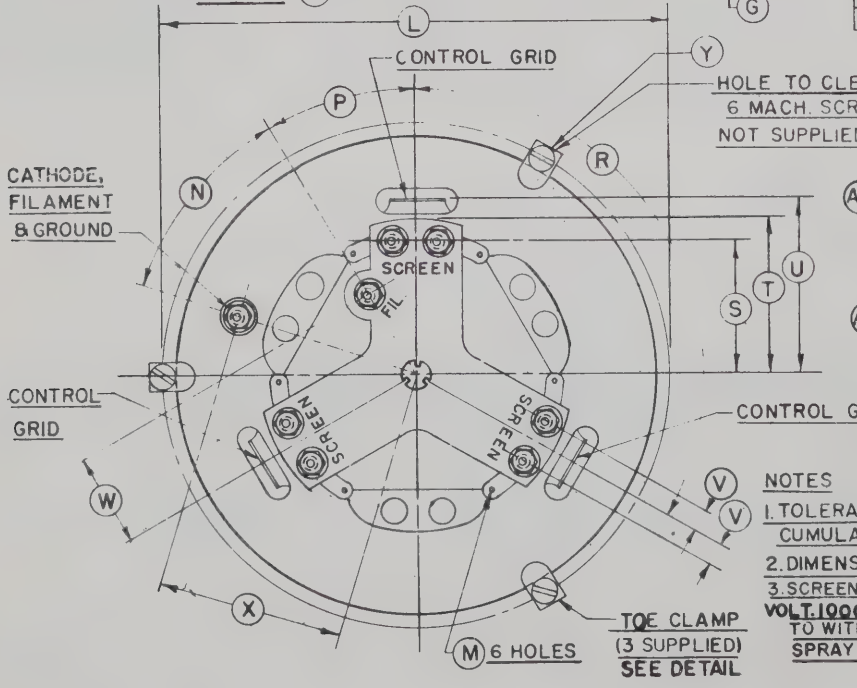
Net Weight	3-¼ ounces
Maximum Height	1-⅞ inches
Maximum Diameter	6-⅛ inches

(Revised 6-1-67) © 1964, 1967 by Varian

Printed in U.S.A.



DIMENSION DATA			
DIM.	MIN.	MAX.	REF.
A	5.290	5.330	
B	5.010	5.047	
C	.790	.860	
D	.990	1.030	
E			.660
F	.550	.590	
G	.420	.500	
H	.110	.140	
J	.500	.540	
K	.422	.452	
L			5.595
M	.057 DIA.	.077 DIA.	
N	40°	42°	
P	29°	31°	
R	119°	112°	
S	1.485	1.530	
T	1.699	1.739	
U	1.917	1.957	
V	.245	.255	
W	1.052	1.072	
X	2.052	2.072	
Y	.142 DIA.		
Z	.078 DIA.	.108 DIA.	
AA			.234
AB	.156 DIA.	.186 DIA.	
AC	.125 R.	.187 R.	
AD	.142	.146	
AE	.292	.332	
AF	.292	.332	
AG	.105	.145	
AH	.417	.457	
AJ	80°	100°	
AK		.062 R.	



NOTE:
REF. DIMS ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.

NOTES
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES
3. SCREEN GRID CAP. 1500 ± 20% mmfd
VOLT. 1000VDC TEST, 400 VDC. INSUL. TO WITHSTAND HUMIDITY & SALT SPRAY PER MIL-STD-202B



EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

TABLE OF CONTENTS

VOLUME I

GENERAL	Effective Date
Tube Type Numbering System	4-3-58
Distributors	5-15-66
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet	
Power Frequency Chart for Power Grid	

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	12-15-65
2-240A	10-21-59
2-450A	3-1-66
2-2000A	7-1-52
2X3000F	6-1-63
250R	12-15-65
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	6-1-66
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65
KY21A	7-1-66
RX21A	1-2-63

TRIODES

2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-15-66
3-1000Z/8164	11-16-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW5000H3	4-1-66
3CW10,000H3	7-15-66
3CW20,000A1	1-1-63
3CW20,000A3	6-1-66
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	11-1-63
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-15-66
3CX2500A3/8161	12-15-64
3CX2500F3	12-15-65
3CX2500H3	3-15-66

TRIODES (Continued)	Effective Date
3CX5000H3	4-1-66
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	11-1-63
3CX10,000H3	3-15-66
3CX15,000A3	4-11-64
3CX15,000H3	4-1-66
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
25T	12-15-65
35T	12-30-57
*35TG	5-1-62
75TH	12-15-65
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	6-15-66
250TL	1-1-61
304TH	4-10-53
304TL	12-15-65
450TH	12-15-65
450TL	12-15-65
592/3-200A3	6-15-66
750TL	12-15-65
1000T	12-15-65
1500T	3-18-59
2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES

4-65A/8165	5-1-62
4-125A	12-15-65
4-250A/5D22	5-1-62
4-400A	8-30-66
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	5-15-66
4CV100,000C/8351	3-15-65
4CW2000A	6-15-66
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61

TETRODES–PENTODES (Continued)	Effective Date
4CX300A/8167	8-30-66
4CX300Y	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX600A	5-7-63
4CX1000A/8168	6-15-66
4CX1000K/8352	8-20-66
4CX1500B	1-15-66
4CX3000A/8169	9-15-65
4CX5000A/8170	10-1-64
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	8-15-66
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	8-30-66
4X150G/8172	6-15-66
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5-500A	11-15-65
5CX1500A	2-15-65

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	8-15-66
HR Heat Dissipating Connectors	12-1-65
SK-300A	11-1-64
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	11-1-65
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	8-15-64
SK-510	8-15-66
SK-600A, SK-610A	11-1-65
SK-606, SK-626, SK-636B	8-15-66
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	8-15-66
SK-760, SK-770	8-15-66
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890, SK-806	4-9-64
SK-900, SK-906	8-15-66
SK-1300	8-15-66
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	5-9-63

*Not recommended for New Equipment Design.

Effective Date 10-15-66

EIMAC
Division of Varian

8438
4-400A

RADIAL-BEAM POWER TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER



The EIMAC 8438/4-400A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the association circuit and driver stage.

The 8438/4-400A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Air-System Socket and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.†

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	14.5	amperes
Grid-Screen Amplification Factor (Average)	5.1	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.12	$\mu\mu$fd
Input	12.5	$\mu\mu$fd
Output	4.7	$\mu\mu$fd
Transconductance (I_b=100ma., E_b=2500V., E_{c2}=500V.)	4,000	μmhos
Frequency for Maximum Ratings	110	MHz

MECHANICAL

Base	See drawing
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	EIMAC HR-6
Recommended Socket	EIMAC SK-400 Air System Socket
Maximum Over-all Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	2.5 pounds

If an Air-System Socket is used, mounted on a ¼ inch deck, the over-all dimensions of the system including chimney and HR-6 Heat Dissipating Plate Connector are:

Length	8.0 inches
Diameter	5.5 inches

Note: Typical operation data are based on conditions of adjusting the rf grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

†Guarantee applies only when the 4-400A is used as specified with adequate air in the SK-400 Air-System Socket or equivalent.

(Revised 8-30-66) © 1955, 1963, 1966, Varian

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 MHz)

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	600 VOLTS
DC PLATE CURRENT	350 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	35 WATTS
GRID DISSIPATION	10 WATTS

TYPICAL OPERATION (Frequencies below 75 MHz, one tube)

DC Plate Voltage	2500	3000	4000 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—200	—220	—220 volts
DC Plate Current	350	350	350 ma
DC Screen Current	46	46	40 ma
DC Grid Current	18	19	18 ma
Screen Dissipation	23	23	20 watts
Grid Dissipation	1.8	1.9	1.8 watts
Peak RF Grid Input Voltage	300	320	320 volts
Driving Power*	5.4	6.1	5.8 watts
Plate Power Input	875	1050	1400 watts
Plate Dissipation	235	250	300 watts
Plate Power Output	640	800	1100 watts

TYPICAL OPERATION (110 MHz, two tubes)

DC Plate Voltage	3500	4000 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	—170	—170 volts
DC Plate Current	500	540 ma
DC Screen Current	34	31 ma
DC Grid Current	20	20 ma
Driving Power (approx.)	20	20 watts
Plate Power Output (approx.)	1300	1600 watts
Useful Power Output	1160	1440 watts

*Driving Power increases as frequency is increased. At 75 MHz the driving power required is approximately 12 watts.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified. One tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3200 VOLTS
DC SCREEN VOLTAGE	600 VOLTS
DC GRID VOLTAGE	—500 VOLTS
DC PLATE CURRENT	275 MA
PLATE DISSIPATION	270 WATTS
SCREEN DISSIPATION	35 WATTS
GRID DISSIPATION	10 WATTS

MAXIMUM RATINGS (Frequencies below 30 MHz, Intermittent Service)

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	600 VOLTS
DC GRID VOLTAGE	—500 VOLTS
DC PLATE CURRENT	275 MA
PLATE DISSIPATION	270 WATTS
SCREEN DISSIPATION	35 WATTS
GRID DISSIPATION	10 WATTS

TYPICAL OPERATION (Frequencies below 75 MHz, Continuous Service)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—220	—220	—220 volts
DC Plate Current	275	275	275 ma
DC Screen Current	30	28	26 ma
DC Grid Current	12	12	12 ma
Screen Dissipation	15	14	13 watts
Grid Dissipation	1.1	1.1	1.1 watts
Peak AF Screen Voltage (100% modulation)	350	350	350 volts
Peak RF Grid Input Voltage	290	290	290 volts
Driving Power	3.5	3.5	3.5 watts
Plate Power Input	550	688	825 watts
Plate Dissipation	170	178	195 watts
Plate Power Output	380	510	630 watts

TYPICAL OPERATION (Frequencies below 30 MHz, Intermittent Service)

DC Plate Voltage	2000	2500	3000	3650 volts
DC Screen Voltage	500	500	500	500 volts
DC Grid Voltage	—220	—220	—220	—225 volts
DC Plate Current	275	275	275	275 ma
DC Screen Current	30	28	26	23 ma
DC Grid Current	12	12	12	13 ma
Screen Dissipation	15	14	13	12 watts
Grid Dissipation	1.1	1.1	1.1	1.2 watts
Peak AF Screen Voltage (100% modulation)	350	350	350	350 volts
Peak RF Grid Input Voltage	290	290	290	315 volts
Driving Power	3.5	3.5	3.5	4.0 watts
Plate Power Input	550	688	825	1000 watts
Plate Dissipation	170	178	195	235 watts
Plate Power Output	380	510	630	765 watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	800 VOLTS
MAX-SIGNAL DC PLATE CURRENT	350 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	35 WATTS
GRID DISSIPATION	10 WATTS

TYPICAL OPERATION CLASS AB_1

(Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	2500	3000	3500	4000 volts
DC Screen Voltage	750	750	750	750 volts
DC Grid Voltage (approx.)*	—130	—137	—145	—150 volts
Zero-Signal DC Plate Current	190	160	140	120 ma
Max-Signal DC Plate Current	635	635	610	585 ma
Zero-Signal DC Screen Current	0	0	0	0 ma
Max-Signal DC Screen Current	28	26	32	40 ma
Effective Load, Plate-to-Plate	6800	8900	11,500	14,500 ohms
Peak AF Grid Input Voltage (per tube)	130	137	145	150 volts
Driving Power	0	0	0	0 watts
Max-Signal Plate Dissipation (per tube)	370	400	400	400 watts
Max-Signal Plate Power Output	850	1110	1330	1540 watts

*Adjust to give stated zero-signal plate current. The DC resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION CLASS AB_2

(Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	2500	3000	3500	4000 volts
DC Screen Voltage	500	500	500	500 volts
DC Grid Voltage (approx.)*	—75	—80	—85	—90 volts
Zero-Signal DC Plate Current	190	160	140	120 ma
Max-Signal DC Plate Current	700	700	700	638 ma
Zero-Signal DC Screen Current	0	0	0	0 ma
Max-Signal DC Screen Current	50	40	38	32 ma
Effective Load, Plate-to-Plate	7200	9100	10,800	14,000 ohms
Peak AF Grid Input Voltage (per tube)	133	140	145	140 volts
Max-Signal Peak Driving Power	8.6	9.0	10.2	7.0 watts
Max-Signal Nominal Driving Power	4.3	4.5	5.1	3.5 watts
Max-Signal Plate Dissipation (per tube)	320	363	400	400 watts
Max-Signal Plate Power Output	1110	1375	1650	1750 watts

*Adjust for stated zero-signal plate current.

PULSE SERVICE — For information on Pulse Service Ratings, "Application Bulletin No. 3, Pulse Service Notes", will be furnished free on request.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATONS

MECHANICAL

Mounting — The 4-400A must be mounted vertically, base up or down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 Air-System Socket. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling — Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System Socket is not used, provision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

ELECTRICAL

Filament Voltage — For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage — The dc bias voltage for the 4-400A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

Screen Voltage — The dc screen voltage for the 4-400A should not exceed 600 volts in rf applications. In audio applications a maximum dc screen voltage of 800 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage — The plate-supply voltage for the 4-400A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

Grid Dissipation — Grid dissipation for the 4-400A should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation
e_{cmp} = Peak positive grid to cathode voltage, and
I_c = dc grid current

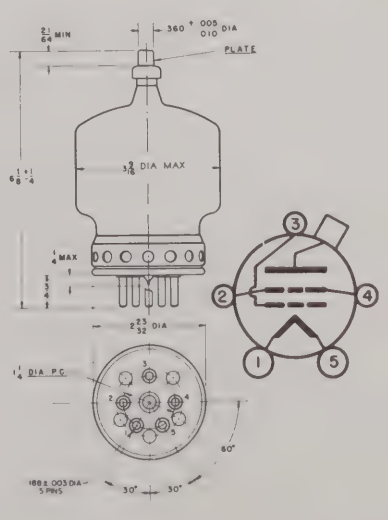
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. (For suitable peak v.t.v.m. circuits see EIMAC Application Bulletin Number 6, "Vacuum Tube Ratings." This bulletin is available on request.)

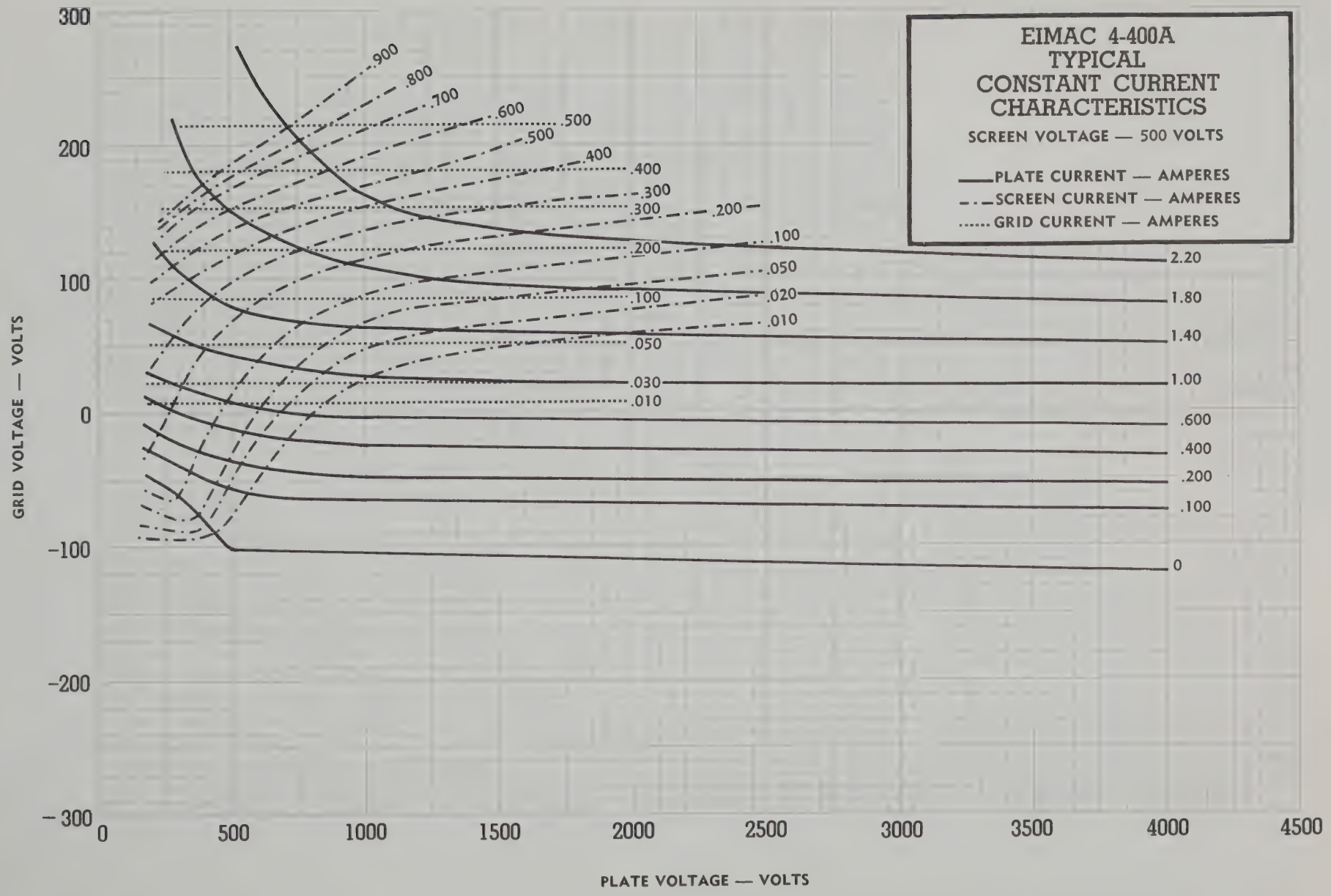
Screen Dissipation — The power dissipated by the screen of the 4-400A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

Plate Dissipation — Under normal operating conditions, the plate dissipation of the 4-400A should not be allowed to exceed 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.




EIMAC 4-400A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
300
200
100
0
−100
−200
−300
0
500
1000
1500
2000
2500
3000
3500
4000
4500
.900
.800
.700
.600
.500
.500
.400
.400
.300
.300
.200
.200
.100
.100
.050
.050
.030
.020
.010
.010
2.20
1.80
1.40
1.00
.600
.400
.200
.100
0

EIMAC
Division of Varian

8167
4CX300A

CERAMIC POWER TETRODE

The EIMAC 4CX300A is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 300 watts. The 4CX300A may be operated at frequencies up to 500 megahertz.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300A especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage (See "Application")		6.0		volts
Current (E_f=6.0 volts)	2.6		3.1	amperes
Amplification Factor (Grid to Screen)	4.0		5.6	
Transconductance (I_b=200 ma.)		12,000		μmhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	25		33	μμf
Output	3.5		4.5	μμf
Feedback			0.06	μμf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input		16.2		μμf
Output	3.5		4.5	μμf
Feedback		0.01		μμf
Frequency for Maximum Ratings			500	MHz

MECHANICAL

Base	Special, breechblock terminal surfaces
Recommended Socket	EIMAC SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Maximum Over-all Dimensions:	
Height	2.5 inches
Diameter	1.65 inches
Net Weight	4 ounces
Shipping Weight (Approximate)	1 pound

(Revised 8-30-66) © 1959, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	300 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

DC Plate Voltage	500	1000	1500	2000	2500‡	2000	volts
DC Screen Voltage	250	250	250	250	250	250	volts
DC Grid Votage	—90	—90	—90	—90	—90	—90	volts
DC Plate Current	250	250	250	250	250	250	ma
DC Screen Current*	45	38	21	19	16	10†	ma
DC Grid Current*	35	31	28	26	25	25†	ma
Peak RF Grid Voltage*	114	114	112	112	111	—	volts
Driving Power*	4.0	3.5	3.2	2.9	2.8	—	watts
Plate Input Power	125	250	375	500	625	500	watts
Plate Output Power	70	190	280	390	500	225†	watts
Heater Voltage						5.0	volts

*Approximate values
†Measured values for a typical cavity amplifier circuit at 500 MHz.
‡For operation below 250Mc. only.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	300 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2000	2500 volts
DC Screen Voltage	350	350	350	350 volts
DC Grid Voltage[1]	—55	—55	—55	—55 volts
Zero-Signal DC Plate Current	200	200	200	200 ma
Max-Signal DC Plate Current	500	500	500	500 ma
Max-Signal DC Screen Current	20	16	10	8 ma
Effective Load, Plate to Plate	3500	6200	9500	11,600 ohms
Peak AF Grid Input Voltage (per tube)*	50	50	50	50 volts
Driving Power	0	0	0	0 watts
Max-Signal Plate Output Power	240	430	600	800 watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	300 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000	2500 volts
DC Screen Voltage	350	350	350	350 volts
DC Grid Voltage[1]	—55	—55	—55	—55 volts
Zero-Signal DC Plate Current	100	100	100	100 ma
DC Plate Current	150	150	150	150 ma
DC Screen Current*	—3	—4	—4	—4 ma
Peak RF Grid Voltage*	25	25	25	25 volts
Plate Output Power	30	50	65	85 watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	300 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000	2500 volts
DC Screen Voltage	350	350	350	350 volts
DC Grid Voltage[1]	—55	—55	—55	—55 volts
Zero-Signal DC Plate Current	100	100	100	100 ma
Peak RF Grid Voltage*	50	50	50	50 volts
DC Plate Current	250	250	250	250 ma
DC Screen Current*	10	8	5	4 ma
Plate Input Power	250	375	500	625 watts
Plate Output Power	120	215	300	400 watts
Two-Tone Average DC Plate Current	190	190	190	190 ma
Two-Tone Average DC Screen Current*	2	—1	—2	—2 ma

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	200 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

DC Plate Voltage	500	1000	1500 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	—100	—100	—100 volts
DC Plate Current	200	200	200 ma
DC Screen Current*	31	22	20 ma
DC Grid Current*	15	14	14 ma
Peak RF Grid Input Voltage*	118	117	117 volts
Driving Power*	1.8	1.7	1.7 watts
Plate Input Power	100	200	300 watts
Plate Output Power	60	145	235 watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtainable by calculation from published characteristic curves and confirmed by direct tests. The driving power and output power shown are substantially correct at frequencies below 175 MHz. Allowance must be made for grid and plate circuit losses. At frequencies above 175 MHz. additional allowance must be made for high-frequency effects within the tube itself. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting — The 4CX300A may be operated in any position. Recommended sockets for the 4CX300A are the EIMAC Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater contact grounded). Both sockets provide connections to all electrodes except the anode and each incorporates a screen by-pass capacitor of approximately 1100 $\mu\mu$f. The SK-606 chimney is recommended for use with the SK-700 and SK-710 sockets.

Other sockets suitable for use with the 4CX300A include the SK-740, SK-760, and SK-770. These sockets do not incorporate screen by-pass capacitors. The SK-760 and SK-770 incorporate integral air chimneys. Screen contacts are connected to the mounting flange in the SK-770 and are, therefore, grounded when the socket is installed in the usual manner.

Cooling — The maximum rated ceramic-to-metal seal temperature for the 4CX300A is 250°C. Adequate forced-air cooling must be provided to assure that this maximum temperature rating is not exceeded. Air flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below.

	Sea Level		10,000 Feet	
Plate Dissipation (watts)	Air Flow (CFM)	Pressure Drop (inches of water)	Air Flow (CFM)	Pressure Drop (inches of water)
100	2.2	0.065	3.2	0.095
150	3.4	0.14	4.9	0.21
200	4.6	0.26	6.7	0.37
250	5.9	0.40	8.6	0.58
300	7.2	0.58	10.5	0.85

A new, more efficient cooling fin design is incorporated in the 4CX300A which results in lower airflow requirements. This is reflected in the table above (which assumes the use of an EIMAC SK-700 or SK-710 socket and SK-606 chimney).

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300A is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

Impact and Vibration — The 4CX300A is designed to operate under impact or vibration capable of disabling a conventional tube of similar power capabilities. Impact forces up to 50g with 11-millisecond duration, or vibratory accelerations up to 20g at frequencies from 20 to 2000 cycles per second, will not destroy a normal 4CX300A unless unduly prolonged.

It is not suggested that the 4CX300A be subjected to abusive treatment unnecessarily, but in applications where operation under severe environmental conditions is unavoidable the 4CX300A will provide more reliable service than will conventional tubes.

ELECTRICAL

Heater Operation — The rated heater voltage for the 4CX300A is 6.0 volts. At frequencies higher than 300 megacycles the heater voltage should be reduced according to the following schedule:

Frequency (MHz)	Heater Voltage (Volts)
Up to 300	6.00
300 to 400	5.75
400 to 500	5.50

The heater voltage must be maintained within $\pm 5\%$ of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation — The 4CX300A employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation — The 4CX300A control grid has a maximum dissipation rating of 2.0 watts, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

At frequencies higher than 300 MHz., the driving power required by the circuits associated with the tube begins to increase, until at 500 MHz., as much as 30 watts of driving power may be required. The power dissipated by the control grid increases only slightly, however, in spite of the greatly increased driving power required by the circuit. Satisfactory 500-megahertz operation of the 4CX300A in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

In class-A and class-AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation — The maximum rated screen dissipation for the 4CX300A is 12 watts. The maximum rated dc screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever

the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated dc values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

A screen by-pass capacitor of approximately 1100 $\mu\mu$f is incorporated in the body of the EIMAC SK-700 and SK-710 Air-System Sockets and is adequate for normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require that additional capacitance be connected externally. In the latter case, the screen by-pass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300A is above the useful high-frequency limit for the tube when either of the sockets with integral screen by-pass capacitors is used.

Plate Operation—The 4CX300A has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300A is 300 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB amplifier applications. When the 4CX300A is used in plate-modulated amplifier applications, the plate-dissipation rating is 200 watts under carrier conditions, rising to 300 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

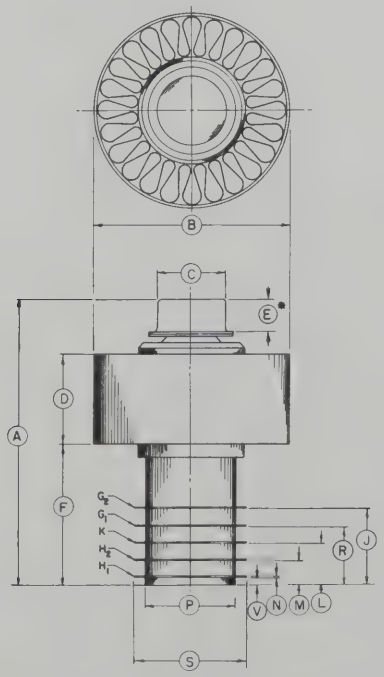
The maximum rated plate voltage for class-AB_1 operation at frequencies up to 500 megahertz is 2500 volts. In class-C telegraphy and plate-modulated service the maximum rated plate voltage for operation up to 500 megahertz is 2000 and 1500 volts respectively. However, at frequencies below 250 megahertz, a plate potential of 2500 volts may be used in class-C telegraphy and FM telephony service.

Modulation — The 4CX300A can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

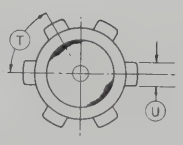
Plate modulation can be applied to the 4CX-300A when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation."

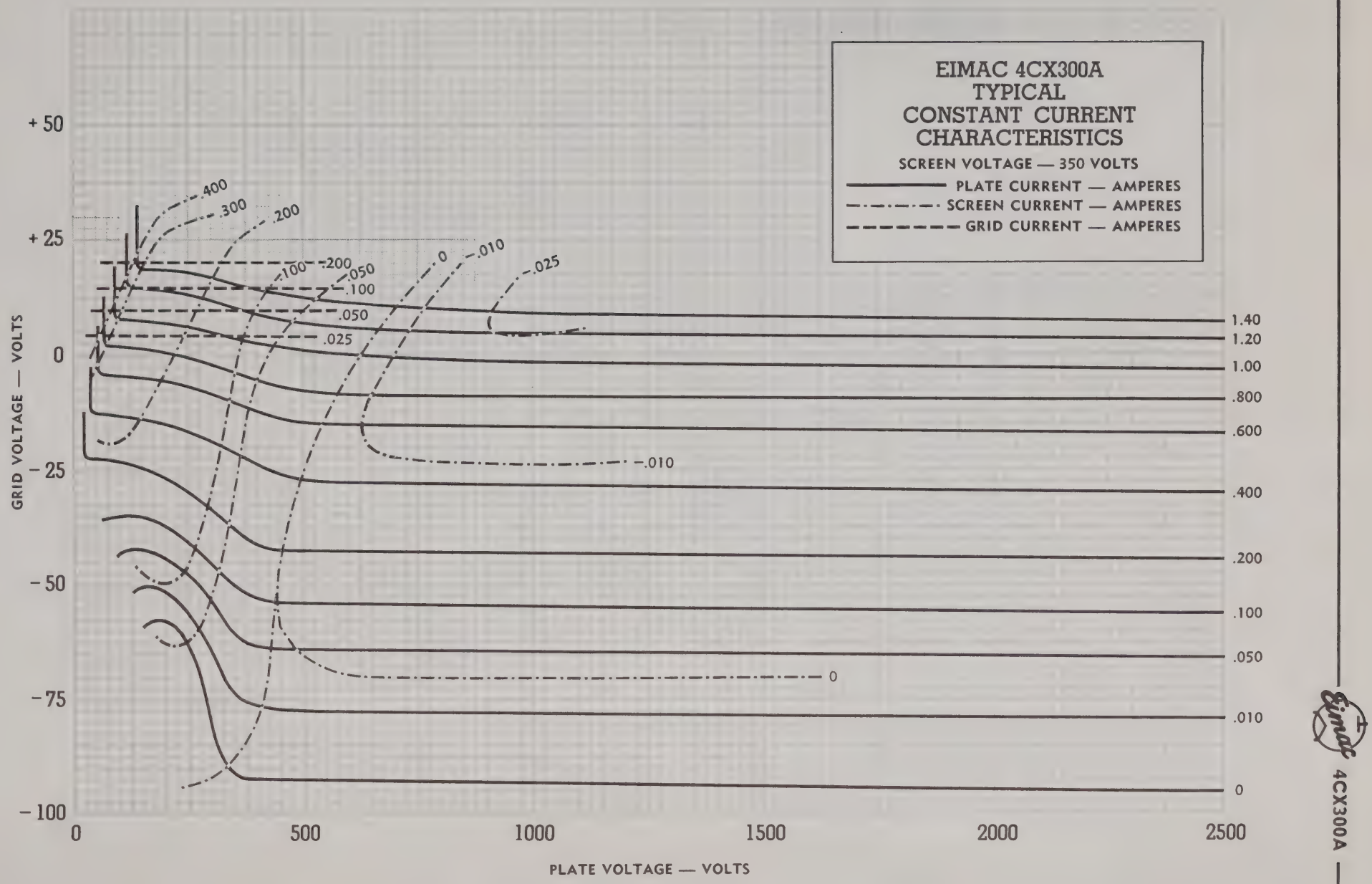
Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to EIMAC, Division of Varian, for information and recommendations.

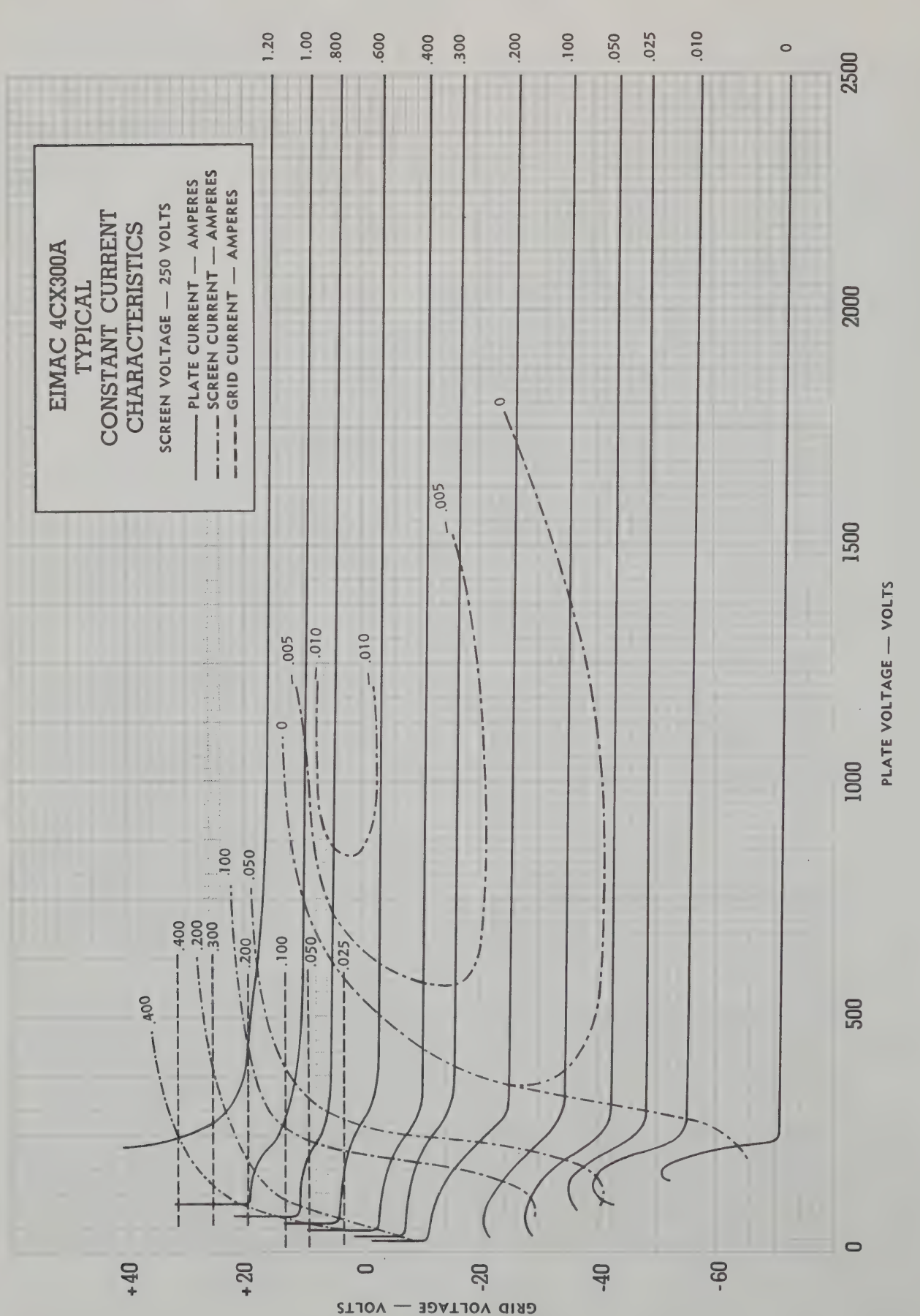


DIMENSION DATA			
REF	NOM.	MIN.	MAX.
A	2.400	2.300	2.500
B	1.625	1.610	1.640
C	.566	.559	.573
D	.750	.710	.790
E		.240	.280
F	1.164	1.133	1.195
J	.622	.602	.642
L	.344	.329	.359
M	.203	.193	.213
N	.015	.010	.020
P	.755	.740	.770
R	.485	.470	.500
S	.946	.936	.956
T	60°		
U	.175	.170	.185
V	.061	.050	.072



*CONTACT SURFACE


EIMAC 4CX300A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
+ 50
+ 25
0
– 25
– 50
– 75
– 100
GRID VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS
.400
.300
.200
.100
.200
.050
.100
.050
.025
0
.010
.025
.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0


EIMAC 4CX300A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.010
.005
0
.400
.200
.300
.200
.100
.050
.025
.400
+40
+20
0
-20
-40
-60
GRID VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8352
4CX1000K

CERAMIC
POWER TETRODE

The Eimac 8352/4CX1000K is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier applications where its high gain and low distortion characteristics may be used to advantage. The 8352/4CX1000K is similar to the 8168/4CX1000A but contains a solid screen ring that improves isolation between input and output circuits and permits use of the tube in UHF service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.022	uuf

	Min.	Nom.	Max.	
Direct Interelectrode Capacitances, Grounded Grid and Screen:*				
Input	32.5		38.0	uuf
Output	11		13	uuf
Feedback			0.004	uuf
Maximum Useable Frequency			400	Mc

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-820 or SK-830
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces

RADIO-FREQUENCY LINEAR AMPLIFIER—Class AB or B

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. WATTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current	890	885	875 mA
Two-Tone Average DC Plate Current	645	650	635 mA
Zero-Signal DC Screen Current*	8	6	5 mA
Single-Tone DC Screen Current*	35	35	35 mA
Two-Tone Average DC Screen Current*	10	8	8 mA
Plate Output Power	930	1300	1630 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

(Revised 8-20-66) © 1964, 1966 Varian

AUDIO AMPLIFIER OR MODULATOR Class AB$_1$

MAXIMUM RATINGS	
DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	500	500	500 mA
Max-Signal DC Plate Current	1.78	1.77	1.75 amps
Zero-Signal DC Screen Current*	16	12	10 mA
Max-Signal DC Screen Current*	70	70	70 mA
Effective Load, Plate to Plate	2040	2850	3680 ohms
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	1860	2600	3260 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

"TYPICAL OPERATION" data are obtained by calculation from published characteristic curves; NO ALLOWANCE is made for circuit losses. Adjustment of the grid bias to obtain the specific zero-signal plate current is assumed. The screen voltage required to obtain the listed value of maximum plate current, without drawing grid current, MAY VARY from the typical values shown. These conditions are valid to approximately 100 Mc. at higher frequencies, power output will be lower due to tube and circuit losses.

APPLICATION

MECHANICAL

Cooling—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes and at UHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CX1000K is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control Grid Operation—The grid dissipation rating of the 4CX1000K is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five milliamperes as read on a five-milliamperes meter may be permitted to flow for peak-signal monitoring purposes.

Screen Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000K and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000K is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the 'Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

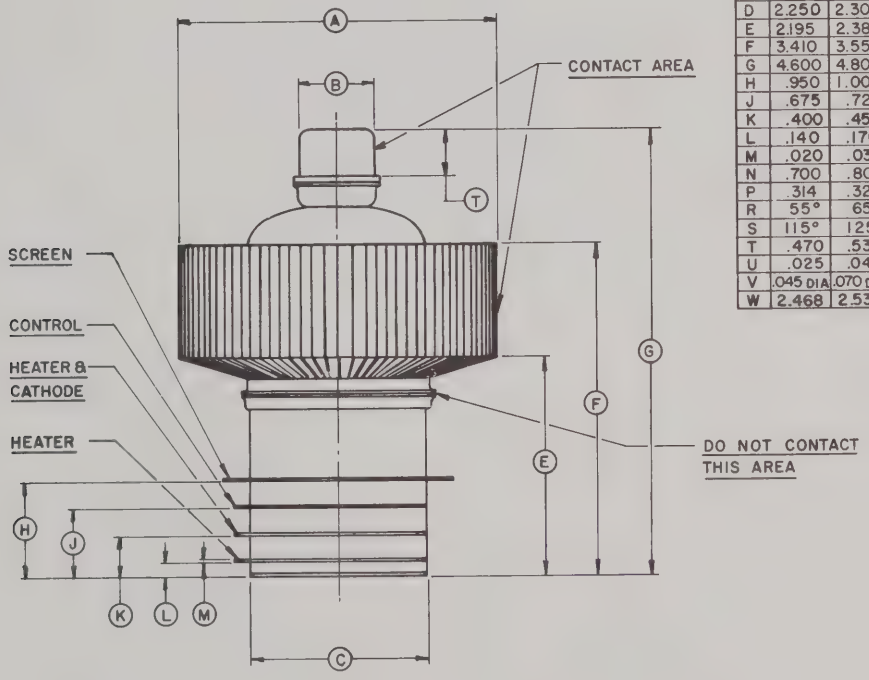
Plate Operation—The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

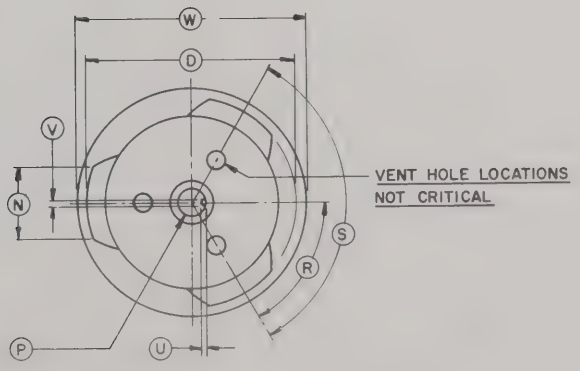
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

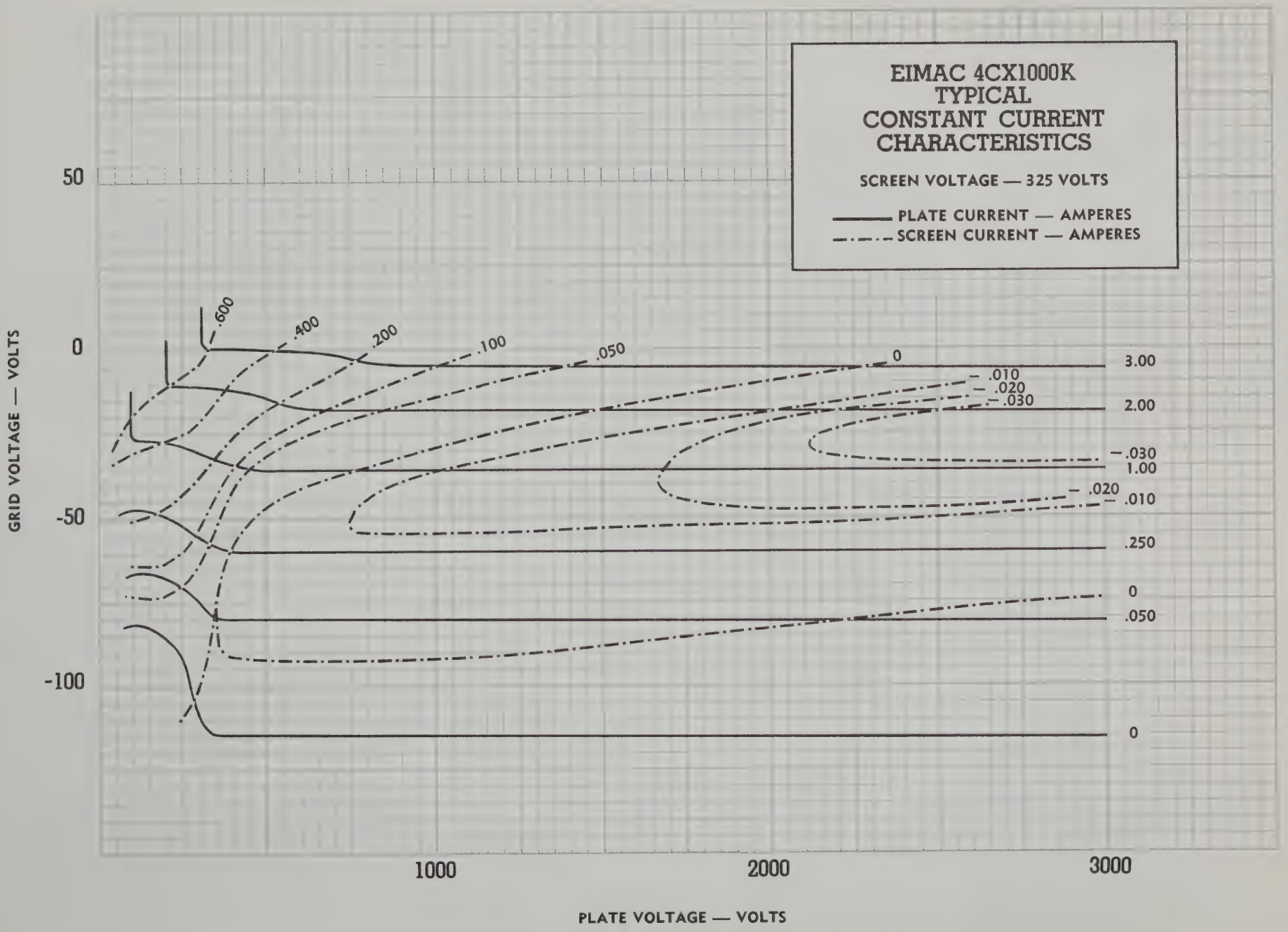
Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Special Applications — If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing, EIMAC, Division of Varian, San Carlos California, for information and recommendations.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	3.335	3.365	
B	.807	.817	
C	1.870	1.900	
D	2.250	2.300	
E	2.195	2.380	
F	3.410	3.550	
G	4.600	4.800	
H	.950	1.000	
J	.675	.725	
K	.400	.450	
L	.140	.170	
M	.020	.030	
N	.700	.800	
P	.314	.326	
R	55°	65°	
S	115°	125°	
T	.470	.530	
U	.025	.048	
V	.045 DIA	.070 DIA	
W	2.468	2.531	






EIMAC 4CX1000K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
1.00
.250
.050

EIMAC
Division of Varian

7034
4X150A
7035
4X150D

RADIAL-BEAM POWER TETRODE

The EIMAC 4X150A and 4X150D tetrodes are compact power tubes intended for use as amplifiers, oscillators, or frequency multipliers at frequencies up to 500 megahertz. The 4X150A is designed to operate with a heater voltage of 6.0 volts, whereas the 4X150D is designed for operation at a heater potential of 26.5 volts. Otherwise, the two tube types have identical characteristics.

Recent improvements in the 4X150A and 4X150D have allowed an increase in maximum plate-dissipation ratings for all classes of service. Further, the maximum plate-voltage rating has been raised for operation at frequencies below 150 megahertz.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage 4X150A		6.0		volts
Current 4X150A	2.3		3.8	amperes
Voltage 4X150D		26.5		volts
Current 4X150D	0.5		0.62	ampere
Amplification Factor (Grid-to-Screen)	4		6	

Direct Interelectrode Capacitances, Grounded Cathode:*	*Min.*	*Max.*
Input	14.5	17.0 μμf
Output	4.0	4.3 μμf
Feedback		0.05 μμf
Frequency for Maximum Ratings		150 MHz
Highest Useful Frequency		500 MHz

*In Shielded Fixture

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Base Seals	175°C
Anode Seal	200°C
Anode Core	250°C
Recommended Socket	EIMAC SK-600 series
Operating Position	Any
Maximum Dimensions:	
Height	2.404 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

(Revised 8-30-66) © 1960, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
Up to 150 megahertz	2000 VOLTS
150 to 500 megahertz	1250 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION	Frequencies up to 150 MHz				500 MHz†	
DC Plate Voltage	500	1000	1500	2000	1250	volts
DC Screen Voltage	250	250	250	250	250	volts
DC Grid Voltage	—90	—90	—90	—90	—80	volts
DC Plate Current	250	250	250	250	200	ma
DC Screen Current*	45	38	21	19	7	ma
DC Grid Current*	35	31	28	26	10	ma
Peak RF Grid Voltage*	114	114	112	112	—	volts
Driving Power	4.0	3.5	3.2	2.9	10	watts
Plate Input Power	125	250	375	500	250	watts
Plate Output Power	70	190	280	390	140	watts

*Approximate values.

†The typical performance figures for 500-megahertz operation were obtained by direct measurement in operating equipment. The output power is **useful** output power measured at the load. The driving power is the total power taken by the tube and a practical resonant circuit.

NOTE: Heater voltage was reduced to 5.5 volts and 24.3 volts for the 4X150A and 4X150D respectively.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
Up to 150 megahertz	1600 VOLTS
150 to 500 megahertz	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 150 megahertz)

DC Plate Voltage	500	1000	1600	volts
DC Screen Voltage	250	250	250	volts
DC Grid Voltage	—150	—150	—150	volts
DC Plate Current	200	200	200	ma
DC Screen Current*	25	20	18	ma
DC Grid Current*	23	21	21	ma
Peak RF Grid Input Voltage*	173	172	172	volts
Driving Power	4.0	3.6	3.6	watts
Plate Input Power	100	200	320	watts
Plate Output Power	47	140	250	watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage[1]	—55	—55	—55	volts
Zero-Signal DC Plate Current	200	200	200	ma
Max-Signal DC Plate Current	500	500	500	ma
Max-Signal DC Screen Current	20	16	10	ma
Effective Load, Plate to Plate	3500	6200	9500	ohms
Peak AF Grid Input Voltage (per tube)*	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	240	430	600	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
Up to 150 megahertz	2000 VOLTS
150 to 500 megahertz	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 150 megahertz)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage[1]	—55	—55	—55	volts
Zero-Signal DC Plate Current	100	100	100	ma
DC Plate Current	150	150	150	ma
DC Screen Current*	—3	—4	—4	ma
Peak RF Grid Voltage*	25	25	25	volts
Plate Output Power	30	50	65	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER, SSB

Class-AB_1 (Single-Tone Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
Up to 150 megahertz	2000 VOLTS
150 to 500 megahertz	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 150 megahertz)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage[1]	—55	—55	—55	volts
Peak RF Grid Voltage*	50	50	50	volts
Zero-Signal DC Plate Current	100	100	100	ma
Single-Tone DC Plate Current	250	250	250	ma
Two-Tone DC Plate Current	190	190	190	ma
Single-Tone DC Screen Current*	10	8	5	ma
Two-Tone DC Screen Current*	2	—1	—2	ma
RF Load Impedance	1750	3100	4750	ohms
Single-Tone Plate Input Power	250	375	500	watts
Single-Tone Plate Output Power	120	215	300	watts

*Approximate values.
[1]Adjust to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

In class-C operation, adjustment of the r-f grid drive to obtain listed plate current at the listed grid bias, screen voltage, and plate voltage is assumed. Resultant screen and grid currents will vary from tube to tube, but little change in output power will be noted.

In class-AB_1 linear operation, screen current will also vary from tube to tube but is a useful indicator of relative linearity. In general, less screen current means better linearity, providing other conditions are held constant. The same degree of linearity will be obtained from different tubes if loading and drive are adjusted to give the same plate and screen currents, although output power may vary from tube to tube.

APPLICATION

MECHANICAL

Mounting — The 4X150A and 4X150D may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

Cooling — Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

Plate Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	3.6	.34	5.25	.5
250	4.8	.55	7.00	.8

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base-cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air-flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Vibration — These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the EIMAC 4CX300A be employed.

ELECTRICAL

Heater — The rated heater voltage for the 4X150A and 4X150D is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ±10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ±5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 megahertz, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency, MHz	4X150A	4X150D
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode Operation — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 milliamperes for plate-modulated operation and 250 milliamperes for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Control Grid Operation — The maximum rated dc grid bias voltage is —250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100-megahertz region, driving-power requirements for amplifiers increase noticably. At 500 megahertz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500-megahertz operation of the tubes in a stable "straight-through" amplifier is indicated by grid-current values below approximately 15 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accom-

modate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissable grid-circuit resistance per tube is 100,000 ohms.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation or plate-modulated rf amplifiers using the 4X150A or 4X150D.

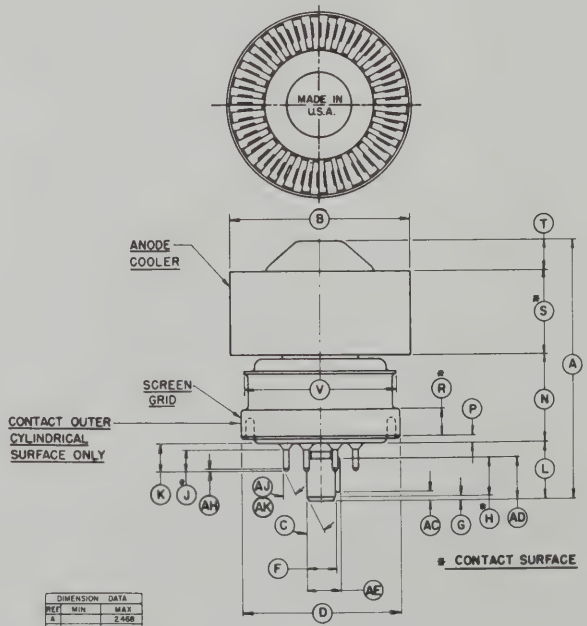
Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

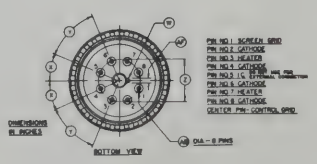
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

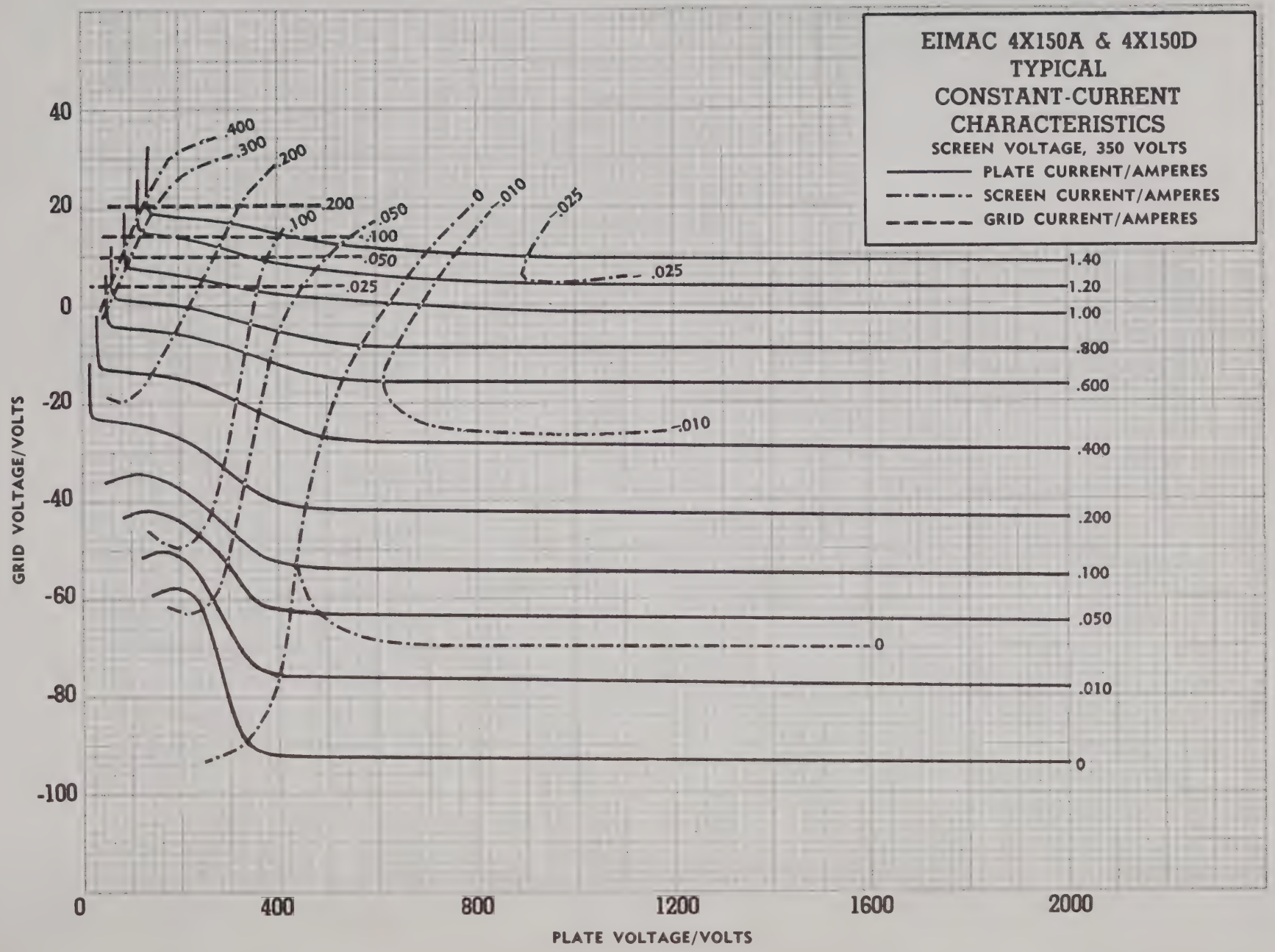
UHF Operation — The 4X150A and 4X150D are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

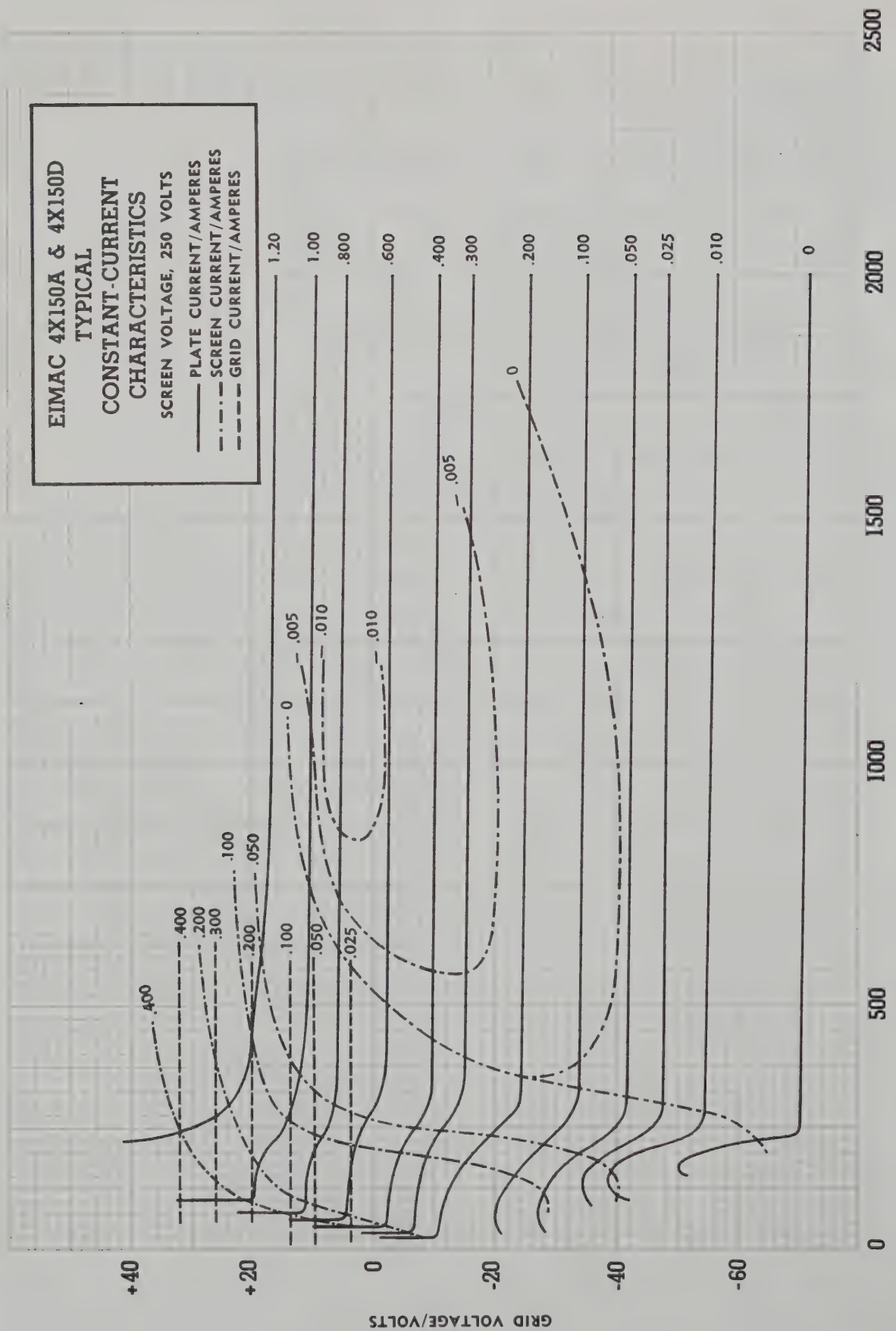
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Engineering, EIMAC Division of Varian, San Carlos, Calif., for information and recommendations.



DIMENSION		DATA
REF	MIN	MAX
A		2.468
B	1.610	1.640
C	30°	
D	1.417	1.433
F	.256	.265
G	45°	
H	.360	
J	.187	
K		.250
L	.514	.554
N	.750	.810
P	.080	
R	.187	
S	.710	.790
T		.312
V		1.406
W		.043R
X	22½°	
Y	45°	
Z	.680	.694
AB	.045	.053
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	.086
AH	.035	
AJ	22½°	
AK	.005R	

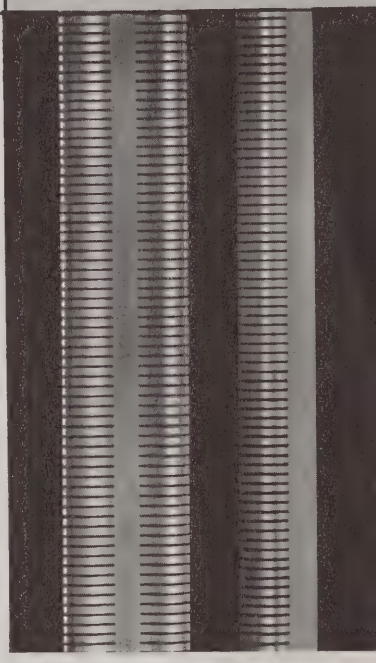



EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
GRID VOLTAGE/VOLTS
PLATE VOLTAGE/VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
.200
.100
.050
.025
0
.010
.025
.025
.010
0


EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
0
.005
.010
.010
.025
.050
.100
.200
.300
.400
.200
.100
.050
.400
+40
+20
0
-20
-40
-60
0
500
1000
1500
2000
2500
PLATE VOLTAGE/VOLTS
GRID VOLTAGE/VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

PREFORMED CONTACT FINGER STOCK



PREFORMED CONTACT FINGER STOCK

EIMAC Preformed Finger Stock is a prepared strip of spring material, slotted and formed into a series of fingers, designed to make a sliding contact.

EIMAC Finger Stock provides excellent circuit continuity between components with adjustable or moving contact surfaces. It is especially suitable for making connections to tubes with coaxial terminals or to moving parts, such as long line and cavity circuits. It is also useful as an electrical "weather stripping" around doors in equipment cabinets and "screen" rooms.

The base material is a non-ferrous spring alloy, heat treated for more positive spring action and silver plated for better rf conductivity. No further forming of the material should be attempted. The minimum bending radius of curvature for the material is 0.75 inch. It may be secured by any suitable mechanical means or by soft soldering. If torch-soldering is attempted, extreme care must be exercised to prevent overheating which will anneal the material, resulting in loss of its elastic properties.

EIMAC Contact Finger Stock is heat treated to a minimum tensile strength of 170,000 pounds per square inch.

EIMAC Contact Finger Stock is available (on special factory order) in the following semi-finished states:

CF-101 through CF-901:	Slotted and formed (Not heat treated or plated)
CF-102 through CF-902:	Slotted, formed, and heat treated (Not plated)
CF-103 through CF-903:	Slotted, formed, and plated (Not heat treated)

Orders should allow approximately ninety days for completion since these semi-finished materials are not carried in stock.

Contact Finger Stock which has not been heat treated can be formed to different shapes by the user, after which it may be heat treated. EIMAC can not undertake heat treatment or plating of semi-finished Contact Finger Stock after it has been further formed by a customer.

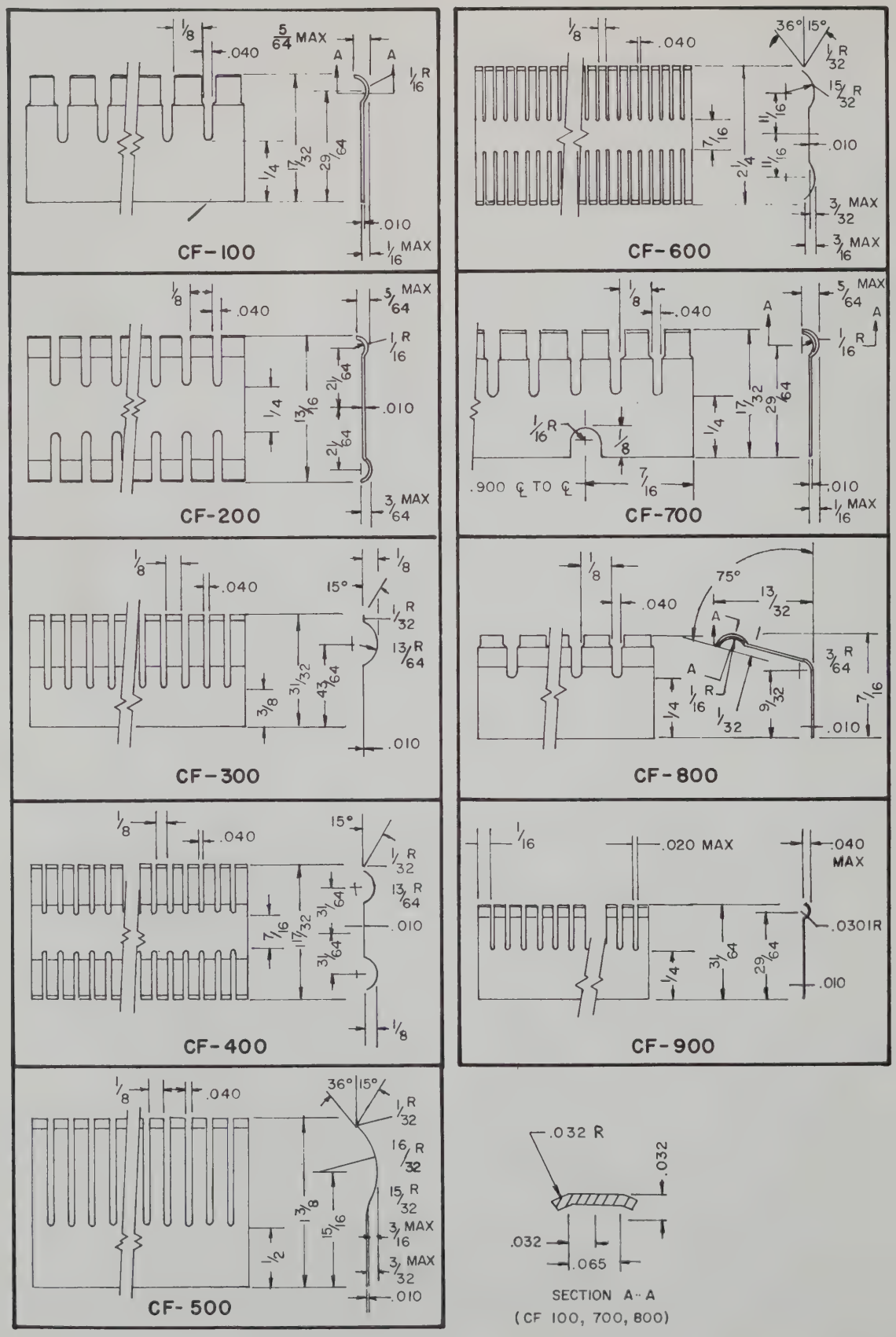
A suitable heat treating schedule consists of holding the unplated material at 600°±5°F for 2.5 hours in air, after which it must be cleaned and plated. Heat treating the material in a controlled atmosphere such as cracked natural gas, disassociated ammonia, or forming gas will minimize oxidation. Finger stock should be held in a suitable jig or fixture during heat treating to prevent deformation.

CF-100, CF-700, and CF-800 incorporate "spooned" fingers to prevent scratching the contact surface (see drawings on reverse side of sheet).

EIMAC Contact Finger Stock is supplied in 36-inch lengths.

(Revised 8-15-66) © 1962, 1966 Varian

Printed in U.S.A.



NOTE—The above dimensions should be regarded as carrying normal manufacturing tolerances because of variations in the shearing, forming and heat-treating processes.

EIMAC
Division of Varian

SK-306
SK-316

AIR-SYSTEM CHIMNEYS

The SK-306 and SK-316 Air-System Chimneys are intended for use with the tube and socket combinations listed below. They are used to direct cooling air to the tube's anode cooling fins after it has been forced through the companion Air-System Socket.

MATERIALS

These chimneys are molded from a white thermosetting polyester premix compound per MIL-R-7575.

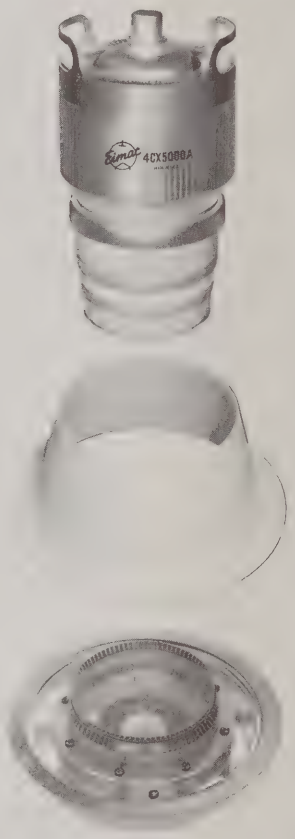
INSTALLATION

The SK-306 mounts above the chassis or plenum and is secured by the eight mounting screws that secure the SK-300 or SK-300A socket.

The SK-316 mounts above the chassis with four separate mounting screws on $8\frac{15}{16}$" diameter pitch circle.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-306	4CX5000A 4CX5000R	SK-300
SK-316	4CX15,000A	SK-300A

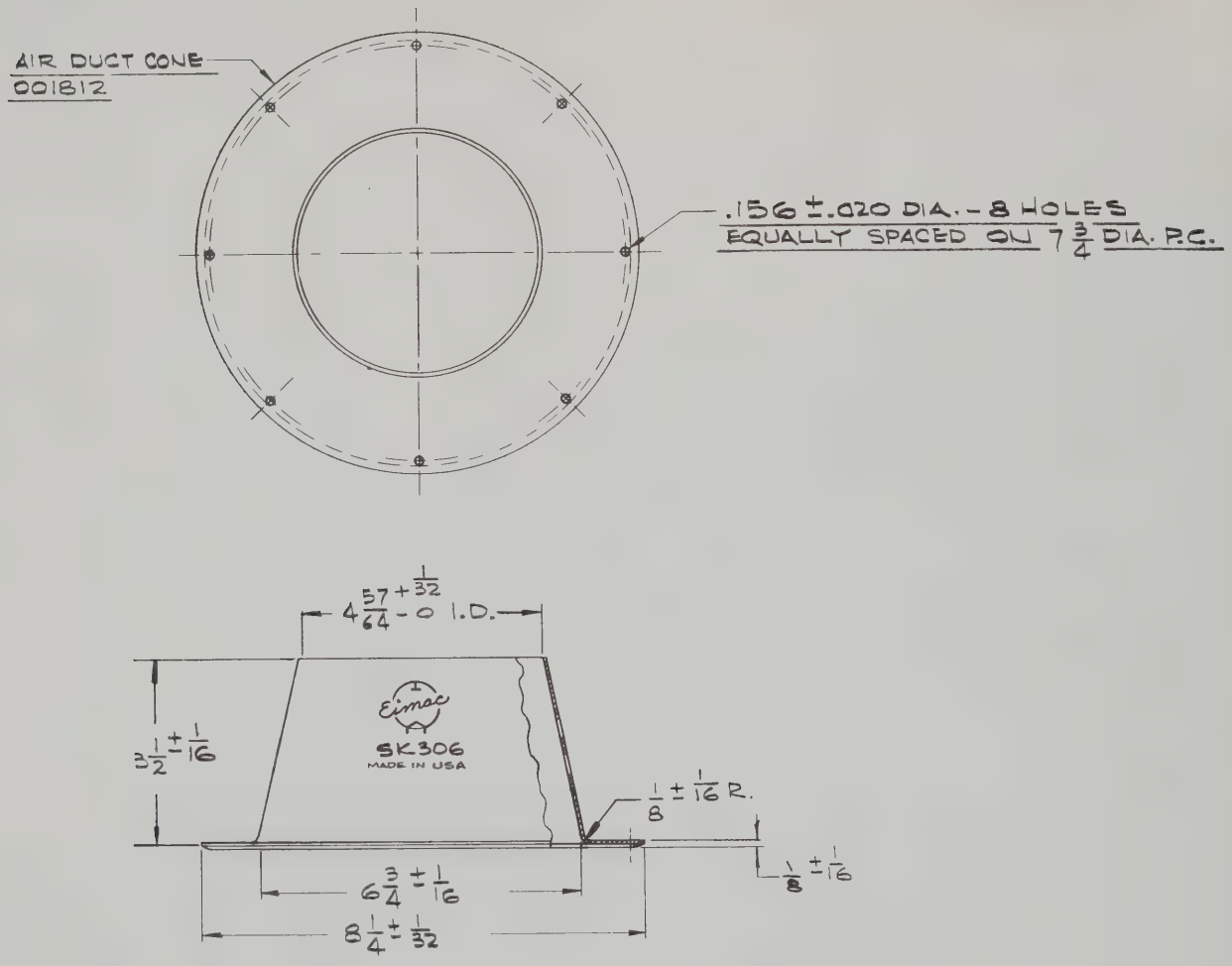


SK-306 Chimney shown with 4CX5000A and SK-300 socket

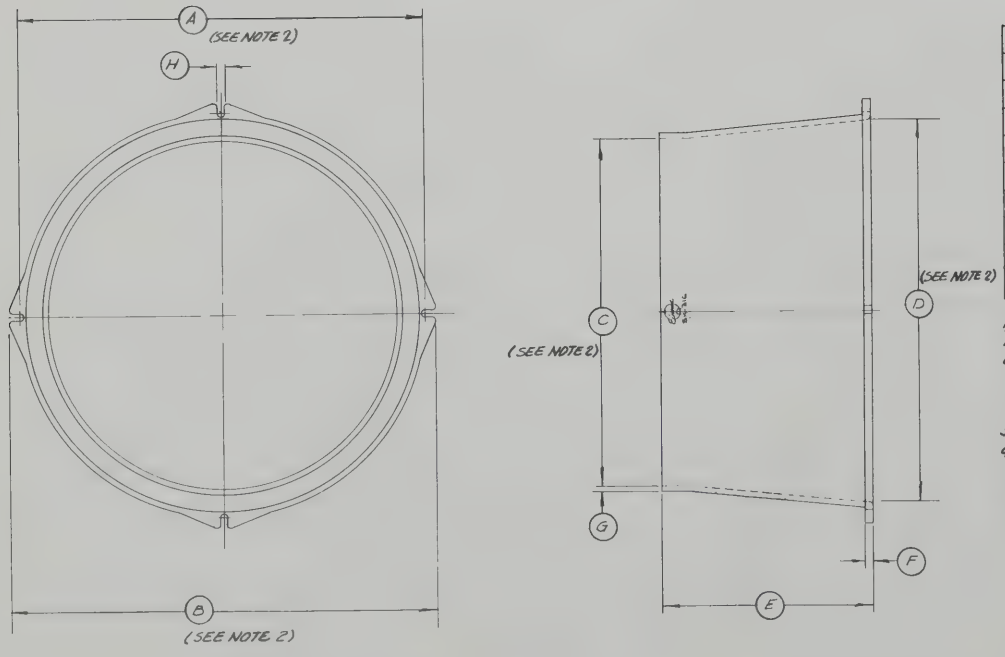
Net Weight - - - - - - - - - - - - - - - - SK-306 — 5.5 ounces
SK-316 — 11 ounces

(Revised 8-15-66) © 1963, 1966 Varian

Printed in U.S.A.



SK-306



DIM.	MIN	MAX.	REF.
A	8.900	8.985	
B	9.262	9.389	
C	7.590	7.652	
D	8.340	8.440	
E	4.606	4.706	
F	.156	.218	
G	.062	.125	
H	.140	.190	

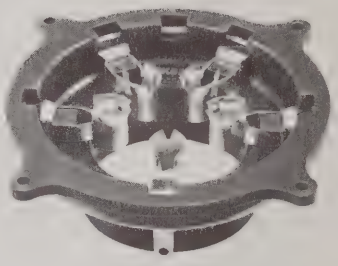
NOTES:
1. DIMS. IN INCHES
2. DIAS. NOTED ARE AVERAGE OF DIA. MEASUREMENTS TAKEN 90° APART WITH PART UNRESTRAINED
3. MAX. OPERATING TEMP. 125°C
4. MAT'L: POLYESTER PRE-MIX COMP. (GREY) FIBERGLASS PER MIL-R -7675.

SK-316

EIMAC
Division of Varian

SK-510

AIR-SYSTEM SOCKET



The EIMAC SK-510 is one of the Air-System Sockets recommended for use with those tube types listed at the bottom of the data sheet or other tube types having the same special five-pin base. Two glass Air-Chimneys are available for use with this socket depending upon the tube type used. The SK-506 Air-Chimney is recommended for use with tube types 4-1000A, 4-1000B and 4PR1000A and the SK-516 Air-Chimney with the 3-1000Z. When this socket is used, connection is made to each of the tube electrodes, except the anode. The SK-510 is humidity and salt-spray resistant.

BASE CONNECTIONS

The SK-510 Air-System Socket consists of five base pin contacting terminals. The terminals are shown on the outline drawing. Four special grounding clips are provided for use with tubes which incorporate metal base shells. It is recommended that these clips be used to prevent the build up of large potentials on the metal shell.

MATERIALS AND FINISHES

The shell or body of the socket is meta-phthalate, per MIL-P-19833. The base contact terminals are fabricated of beryllium-copper, per QQ-C-533, heat-treated after forming, then silver-plated, per QQ-S-365. Eight clips are provided for grounding the metal base shell and holding the Air-Chimney. They are fabricated of beryllium-copper, heat-treated after forming, then cadmium-plated, per QQ-P-416.

INSTALLATION

The SK-510 Air-System Socket can be mounted on a chassis deck, partition or pressurized compartment. Chassis mounting is accomplished by cutting a 3¾" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by four 6-32 machine screws through the four screw holes provided for fastening. This socket has a 2⅜" O.D. round neck extending ¾" below the main socket body which provides means for connecting any standard type air-duct to the base. Four additional clips are provided for holding the Air-Chimney.

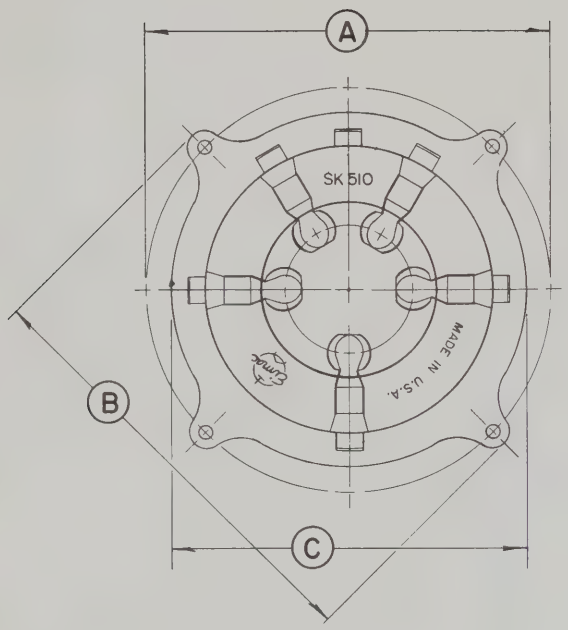
The SK-510 Air-System Socket is Recommended for use with the following tube types:

3-1000Z	4-1000B
4-1000A	4PR1000A

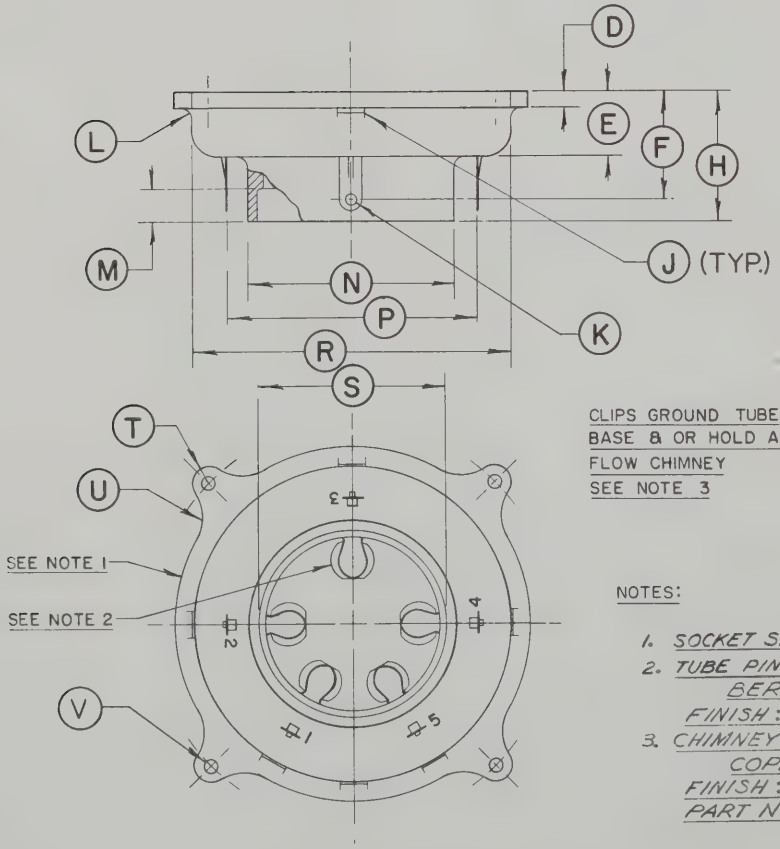
NET WEIGHT - - - - - - - - - - - - - - - - - 6.5 ounces

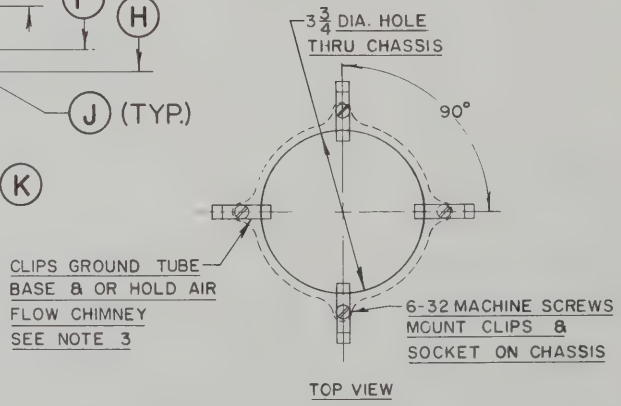
(Revised 8-15-66) © 1963, 1966 Varian

Printed in U.S.A.



DIMENSION DATA			
DIM	MIN.	MAX.	REF
A	4.593 DIA	4.656 DIA	
B	4.968	5.031	
C	4.031 DIA	4.093 DIA	
D	.156	.218	
E	.718	.781	
F			1.250
H	1.468	1.531	
J	.031 × .281	.093 × .343	
K	.093 DIA	.156 DIA	
L	.093 R	.156 R	
M	.343	.406	
N	2.343 DIA	2.406 DIA	
P			2.890
R	3.593 DIA	3.656 DIA	
S	2.140 DIA	2.203 DIA	
T			.187 R
U			.500 R
V	.139 DIA	.152 DIA	





NOTES:

1. SOCKET SHELL - MAT'L : DIALLYL PHTHALATE.
2. TUBE PIN CONTACT CLIPS - MAT'L : BERYLLIUM COPPER. HEAT TREATED. FINISH : SILVER PLATED.
3. CHIMNEY CLIPS - MAT'L : BERYLLIUM COPPER, HEAT TREATED. FINISH : CADMIUM PLATED. PART NO. : 115844N PER EIMAC DWG 115842.

EIMAC
Division of Varian

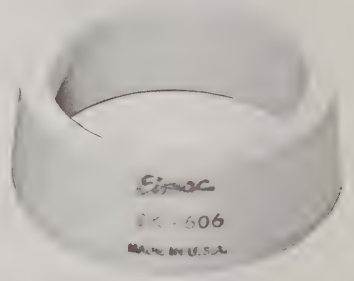
SK-606
SK-626
SK-636B

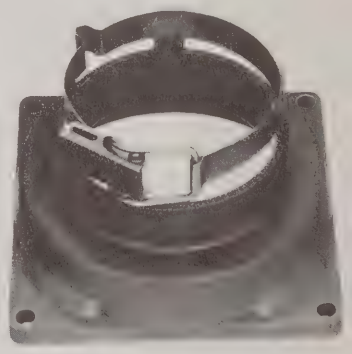
AIR-SYSTEM CHIMNEYS

The EIMAC SK-606, SK-626 and SK-636B Air-System Chimneys are intended for use with those tube and socket combinations listed below.

They are used to direct cooling air into the anode radiator on the tube types listed below.

The SK-636B also helps hold the tube in place by means of a clamping band around the tube's radiator.





MATERIALS

The SK-606 and SK-626 are made of high temperature ceramic. The SK-636B is molded of diallyl meta-phthalate per MIL-P-19833. The clamping band on this socket is made of beryllium copper per QQ-S-365. A neoprene "O" ring is furnished in a recess at the bottom of the socket to more effectively seal the chimney to the socket.

INSTALLATION

The SK-606 and SK-626 ceramic chimneys are installed by slipping them over the tube radiator. They are held in place by their own weight or by some suitable clamping means.

The SK-636B is secured to the chassis over the companion Air-System Socket by means of four #6 screws.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	SOCKET	TUBE
SK-606	SK-600 SK-600A SK-610 SK-640	4X150A 4X150D 4X150R 4X150S
SK-626 SK-636B	SK-620 SK-620A SK-630 SK-630A	4CX250B 4CX250F 4CX250R 7580
SK-606	SK-700 SK-710 SK-711A	4CX300A 4CX300Y

Net Weight - - - - - - - - - - - - - - -

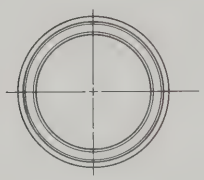
SK-606 — 1.4 ounces
SK-626 — 1.4 ounces
SK-636B — 1.4 ounces

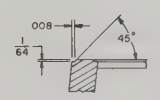
(Revised 8-15-66) © 1963, 1966 Varian

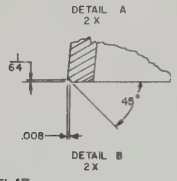
Printed in U.S.A.

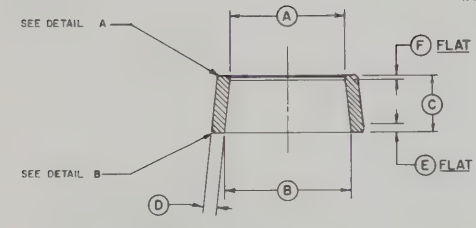
DIMENSION DATA

REF.	MIN.	MAX.	NOM.
A	1.645	1.680	
B	1.812	1.850	
C	.812	.875	
D	.156	.218	
E	109	.140	
F	.046	.078	

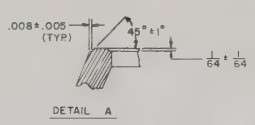


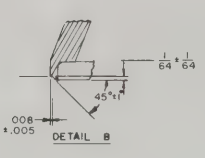






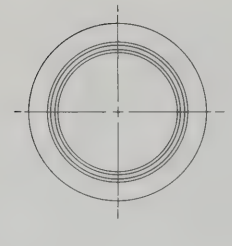
SK-606

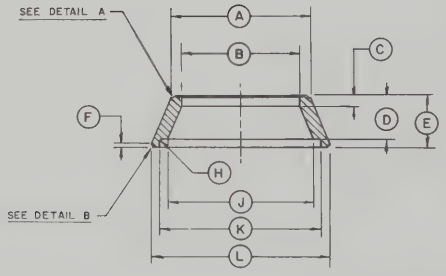




DIMENSION DATA

REF.	MIN.	MAX.	NOM.
A	1.980	2.020	
B	1.650	1.720	
C	.105	.145	
D	.573	.613	
E	.698	.738	
F	.042	.082	
H			1/32 R.
J	2.022	2.082	
K	2.300	2.362	
L	2.511	2.551	



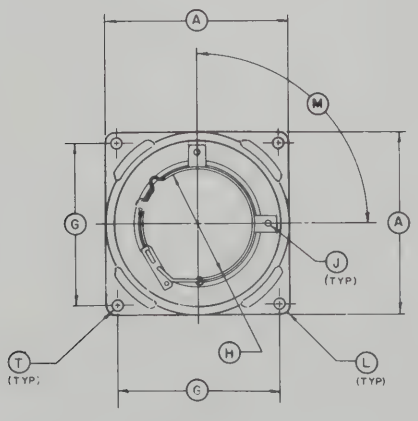


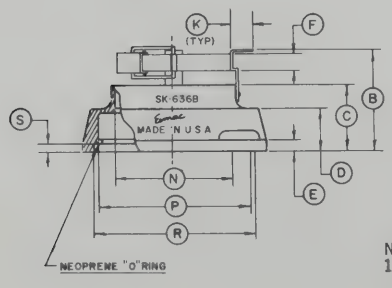
SK-626

DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.609	2.641	
B	1.607	1.677	
C	1.109	1.141	
D	.560	.600	
E	.155	.187	
F	.219	.281	
G	2.335	2.365	
H	1.580	1.620	
J	.083	.103	
K	.281	.343	
L			1/8 R
M			90°
N	1.651	1.661	
P	2.310	2.320	
R	2.492	2.502	
S	.111	.121	
T	.151	.161	





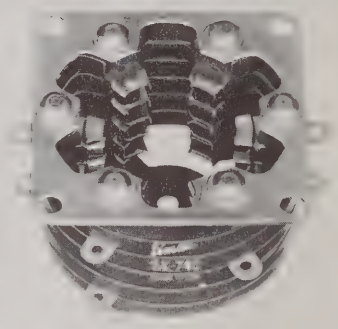
NOTES
1 STRAP & BRACKETS OF CLAMP - MATL BE CU PER FED SPEC QQ-C-533 SILVER PLATED AS PER QQ-S-365
2 CHIMNEY-MATL DIALLYL META-PHTHALATE PER MIL-P-19833
3 CLAMP PROVIDES A MIN. 3 LBS. RETENTION ON A 1.625 DIA. TUBE

SK-636B

EIMAC
Division of Varian
SAN CARLOS

SK-740

AIR-SYSTEM SOCKET



The EIMAC SK-740 Air-System Socket is recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. This socket is not intended for use with an Air-Chimney, but is particularly useful in applications where transverse air cooling, heat-sink or immersion cooling is intended. When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-740 is humidity and salt-spray resistant.

BASE CONNECTIONS

The SK-740 socket consists of five sets of ring contacts: they are from top to bottom: 1. screen-grid, 2. control-grid, 3. cathode, 4. heater, 5. heater. Each set of contacts consist of six separate contacting tabs. The tube elements are connected to their external circuits by two diametrically-opposed solder tabs. The SK-740 has no grounded contacts.

MATERIALS AND FINISHES

The mounting plate of the socket is fabricated of nickel-plated brass. The contact rings and tabs are of beryllium copper, per QQ-C-533, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. All silver-plating per QQ-S-365 and nickel-plating per QQ-N-290. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the socket are molded of a flameproof diallyl meta-phthalate, per MIL-P-19833.

INSTALLATION

The SK-740 Air-System Socket is designed for under-chassis mounting and requires a 1.593 inches diameter hole through the chassis deck. Four screw holes are provided for fastening as shown in the outline drawing.

The SK-740 Air-System Socket is recommended for use with the following tube types:

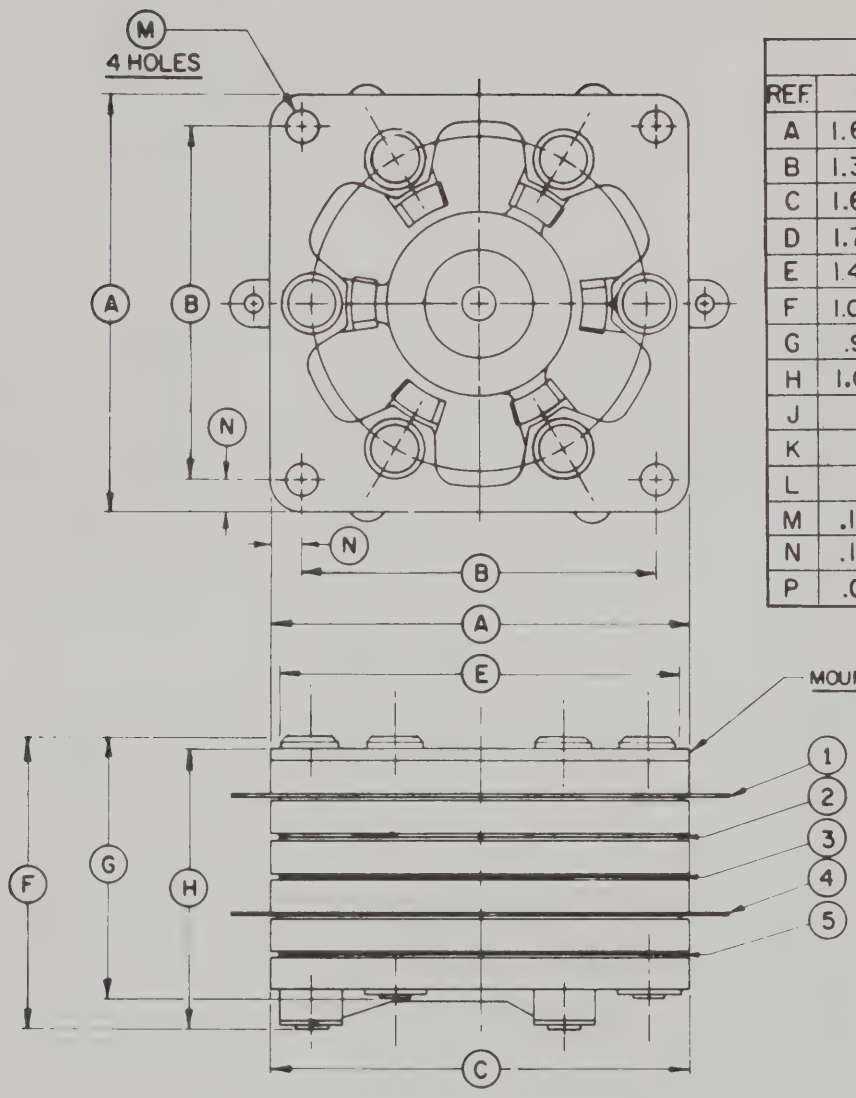
4CN15A	4CX300A
4CX125C	4CX300Y
4CX125F	

Note: A separate means of directing air is required when using the SK-740 with the 4CX300A and 4CX300Y. For applications using these two tubes, the SK-760 and SK-770 Air-System Sockets are recommended. These contain an integral chimney.

NET WEIGHT - - - - - - - - - - - - - - - - - - 1.5 ounces

(Revised 8-15-66) © 1963, 1966 Varian

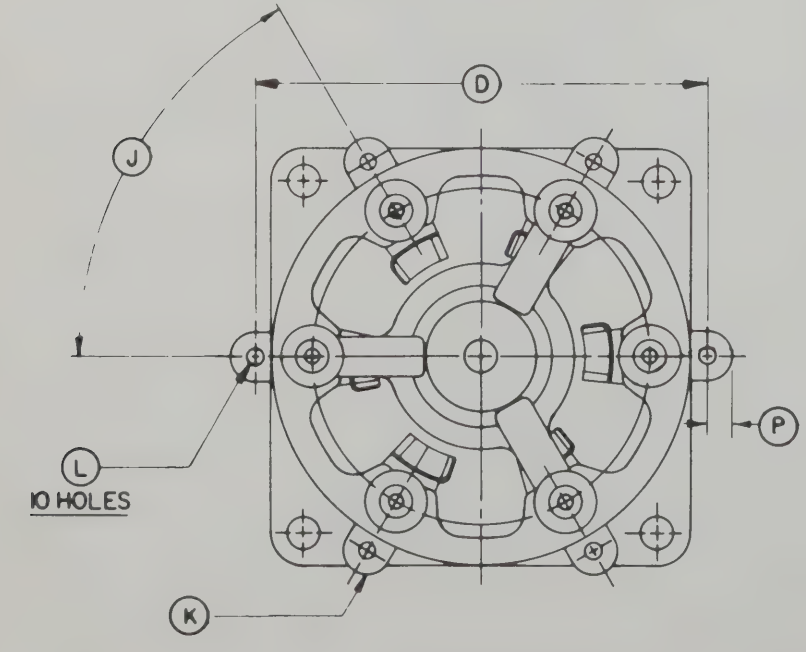
Printed in U.S.A.



DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	1.615	1.635	
B	1.360	1.390	
C	1.615 DIA.	1.635 DIA.	
D	1.735	1.765	
E	1.485	1.575	
F	1.070	1.110	
G	.925	.965	
H	1.020	1.060	
J			60°
K			3/32R
L			1/16 DIA.
M	.134 DIA.	.154 DIA.	
N	.120	.130	
P	.078	.109	

CONNECTIONS

1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER



EIMAC
Division of Varian

SK-760
SK-770

AIR-SYSTEM SOCKETS



The EIMAC SK-760 and SK-770 Air-System Sockets are recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. These sockets incorporate a built-in integral chimney. When these sockets are used, connection is made to each of the tube electrodes except the anode. The screen contacts on the SK-760 are not connected to the metal mounting plate, while the screen contacts on the SK-770 are connected to the metal mounting plate. The SK-760 has no grounded contacts. The SK-760 and SK-770 are humidity and salt spray resistant.

BASE CONNECTIONS

The SK-760 and SK-770 Air-System Sockets consist of five sets of ring contacts; they are from top to bottom: 1. screen-grid, 2. control-grid, 3. cathode, 4. heater, 5. heater. Each set of contacts consist of six separate contacting tabs. The tube elements are connected to their external circuits by two diametrically opposed solder tabs.

MATERIALS AND FINISHES

The mounting plates of these sockets are fabricated of silver-plated brass. Contact rings and tabs are made of beryllium copper, per QQ-C-533, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. All silver-plating is in accordance with QQ-S-365 and nickel-plating per QQ-N-290. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the sockets are molded of a flameproof diallyl meta-phthalate per MIL-P-19833.

INSTALLATION

The SK-760 and SK-770 Air-System Sockets were designed for under-chassis mounting and require a 1.593 inches diameter hole through the chassis deck and four screw holes are provided for fastening as shown on the outline drawing.

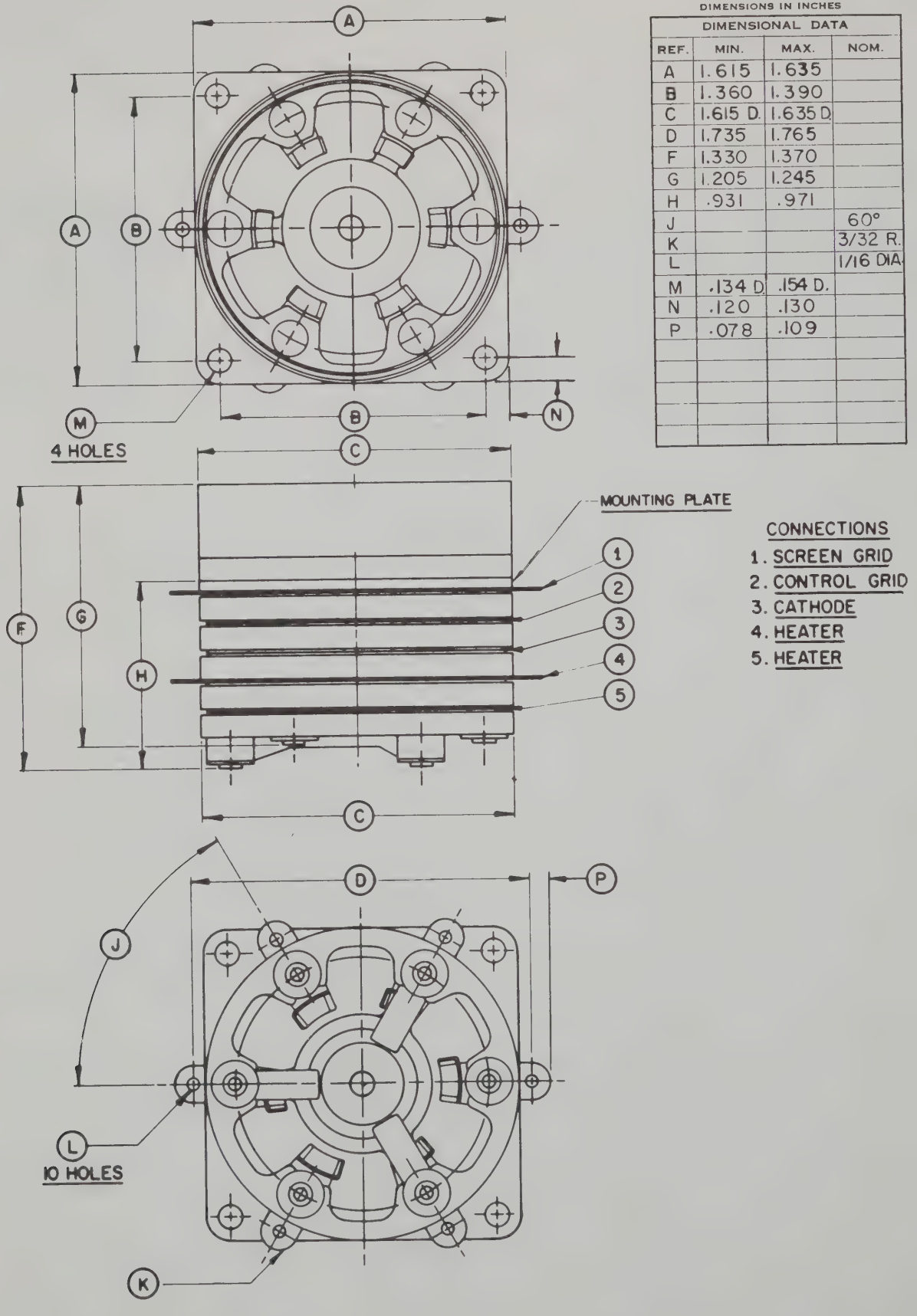
The SK-760 and SK-770 Air-System Sockets are recommended for use with the following tube types:

4CX300A 4CX300Y

NET WEIGHT - - - - - - - - - - - - - - - - - - 1.5 ounces

(Revised 8-15-66) © 1963, 1966 Varian

Printed in U.S.A.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.615	1.635	
B	1.360	1.390	
C	1.615 D.	1.635 D.	
D	1.735	1.765	
F	1.330	1.370	
G	1.205	1.245	
H	.931	.971	
J			60°
K			3/32 R.
L			1/16 DIA.
M	.134 D.	.154 D.	
N	.120	.130	
P	.078	.109	

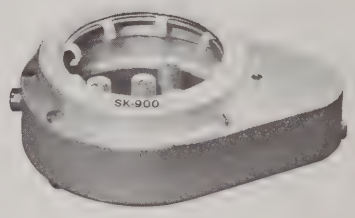
CONNECTIONS

1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER

EIMAC
Division of Varian

SK-900
SOCKET
and
SK-906
CHIMNEY

The EIMAC SK-900 Air-System Socket and companion SK-906 Air Chimney are intended for use with the EIMAC 4X500A. The socket makes connection to each of the tube electrodes except the anode. A screen-grid by-pass capacitor is incorporated as an integral part of the socket.



BASE CONNECTIONS

Filament, control-grid, and screen-grid pins of the tube are engaged by four self-aligning pin-jacks supported in a disk of low-loss material and terminating in 10-32 studs. The connecting leads to these studs must be sufficiently flexible to allow free movement of the pin-jacks or the self-aligning feature will be impaired. The supporting insulating disk rests on a shoulder turned into the bottom of the socket body and is held in place by four machine screws which act as clamps. This design permits the insulation and terminal assembly to be rotated to any convenient position and clamped firmly in place.



SCREEN-GRID BY-PASS CAPACITOR

This capacitor utilizes polyester film as the dielectric and is encapsulated in epoxy resin. The capacitance is 650 $\mu\mu$f±20% and is rated at 700 working volts. One side of the by-pass capacitor contacts the screen-grid flange of the tube through eight spring fingers and the other side is directly connected to the socket body.

INSTALLATION

The SK-900 Air-System Socket is designed for under-chassis mounting and requires a 3⅝-inch hole through the chassis deck. The socket is held in place by four 8-32 machine screws running through the chassis and into tapped holes in the cast aluminum socket body. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

An air blower may be connected to the socket air-inlet by means of a duct terminating in a cylindrical fitting of 1¼-inch OD or the entire chassis may be pressurized.

Pressure drop across the socket and tube (with SK-906 installed may be measured by a manometer arranged to indicate the pressure difference between the air in the socket (or pressurized chassis) and the surrounding air. A ¼-28 tapped hole is provided in the socket body to facilitate the installation of a fitting. A suitable fitting will have a hole diameter of approximately 1/64-inch and when installed, must be flush with the inner wall of the socket to avoid inaccurate pressure measurements.

SK-906 AIR CHIMNEY

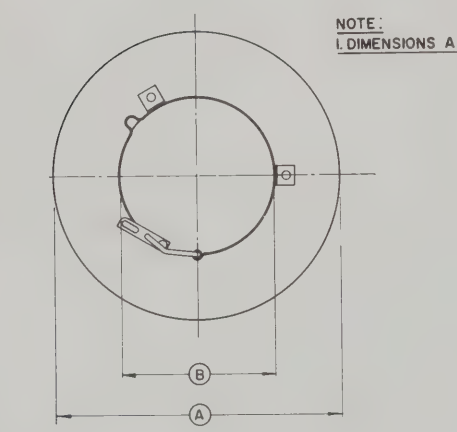
The air chimney is molded of fiber-glass reinforced silicone resin and fitted with an anode clamp. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-900 Air-System Socket.

(Revised 8-15-66) © 1963, 1966 Varian

Printed in U.S.A.

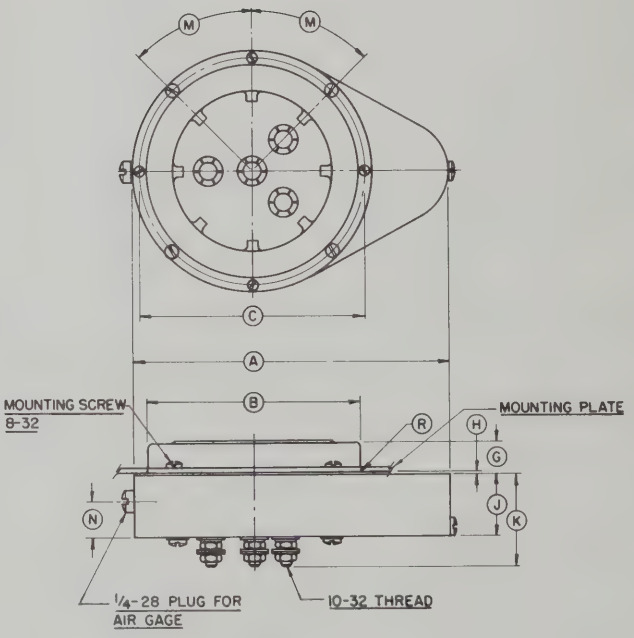
DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	3.720 DIA.	3.785 DIA.	
B	1.990 I.D.	2.010 I.D.	
C	3/8	7/16	
D	1.715	1.735	
E	.510	.530	
F			13/32 R.
G	9°	11°	

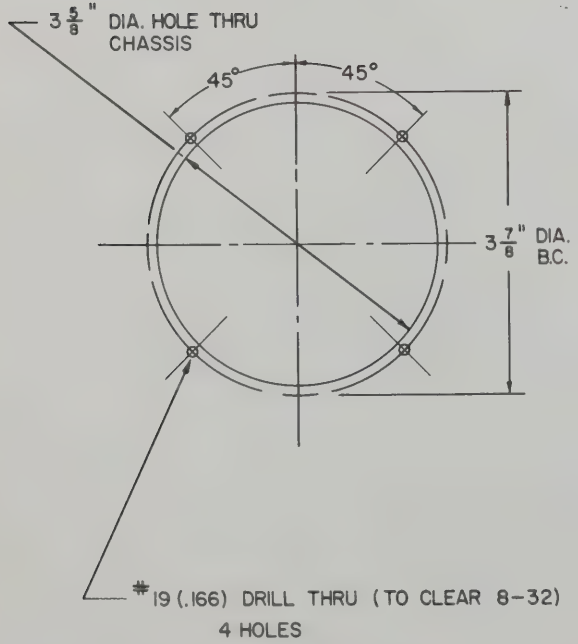
NOTE:
1. DIMENSIONS ARE IN INCHES.



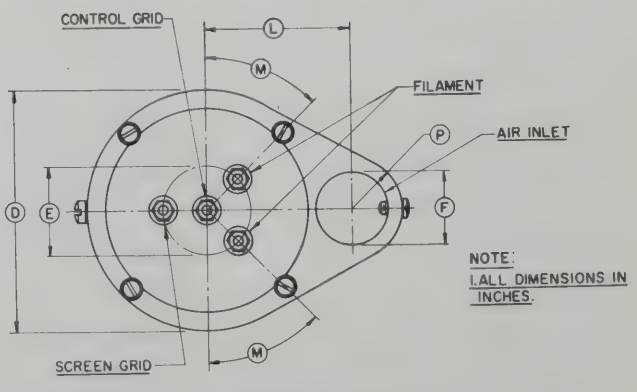
SK-906 CHIMNEY

DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	5 3/8	5 1/2	
B	3.595 DIA.	3.605 DIA.	
C	3.864 DIA.	3.884 DIA.	
D	4 1/16 DIA.	4 3/16 DIA.	
E	1.490 DIA.	1.510 DIA.	
F	1.248 DIA.	1.263 DIA.	
G	.512	.532	
H	.040	.060	
J	1 3/64	1 5/64	
K	1 33/64	1 37/64	
L	2 15/32 DIA.	2 17/32 DIA.	
M	44°	46°	
N	19/32	21/32	
P	27/32 R.	29/32 R.	
R			.031 R





SK-900 CHASSIS DRILLING

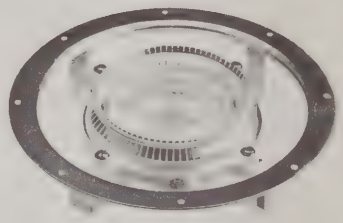


SK-900 SOCKET

EIMAC
Division of Varian

SK-1300

AIR-SYSTEM SOCKET



The EIMAC SK-1300 Air-System Socket has been designed for use with the tube types listed at the bottom of this sheet. The socket is intended for mounting on a pressurized chassis or plenum, allowing air-cooling of the tube base and terminals.

BASE CONNECTIONS

The SK-1300 Air-System Socket is provided with three concentric rings of spring contact fingers for making contact to the filament and the grid of the coaxial triodes listed below.

The filament contact fingers are terminated on two bus connections to insure good high frequency current distribution. Each of these two bus rings is provided with two lugs for making external connections.

The grid spring-finger contacts are terminated on a heavy support assembly. This assembly is in turn fitted with four 6-32 brass screws equally spaced around the periphery for grid circuit connections. The grid contact assembly is insulated from the socket cup.

MATERIALS AND FINISHES

The contact fingers are a non-ferrous spring alloy, heat-treated for positive spring action and silver-plated for good rf conductivity. The socket body and socket cup (support ring) are made of silver-plated brass.

INSTALLATION

The SK-1300 is supported by the socket cup on a pressurized compartment or chassis. A 7⅛″ diameter hole is required in the supporting chassis or plenum and the socket is secured by eight #6 machine screws on a 7¾″ pitch circle.

The socket cup is open so that air may be directed through it for cooling of the base terminals.

CHIMNEY

A companion Air-Chimney, the SK-1306, is available for use with the SK-1300 and the air-cooled tubes 3CX10,000A1, 3CX10,000A3 and 3CX10,000A7 listed below. The chimney is mounted above the chassis deck and is installed using the same eight mounting screws used for securing the SK-1300 socket.

Use of the Air-Chimney allows simplified cooling of the tube; air forced through the socket is directed through the Air-Chimney and then through the tube's anode cooling fins.

The SK-1300 is used with the following tubes:

3CX10,000A1	3CW20,000A1	3CV30,000A3*
3CX10,000A3	3CW20,000A3	
3CX10,000A7	3CW20,000A7	

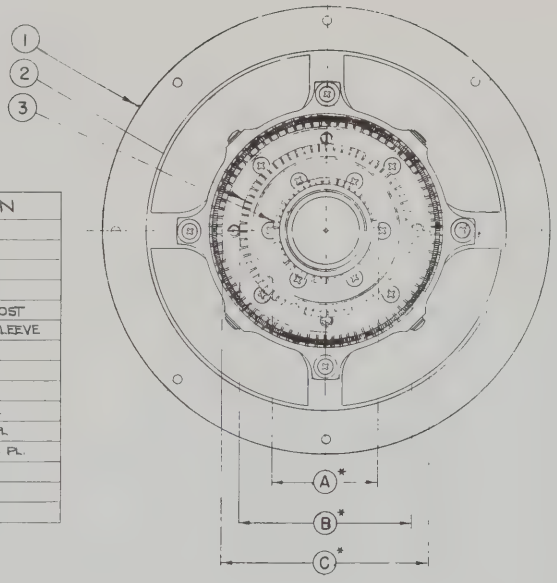
*Where a "floating" socket is desired, the SK-1310 should be used.

NET WEIGHT - - - - - - - - - - - - - - - - - 1.3 pounds

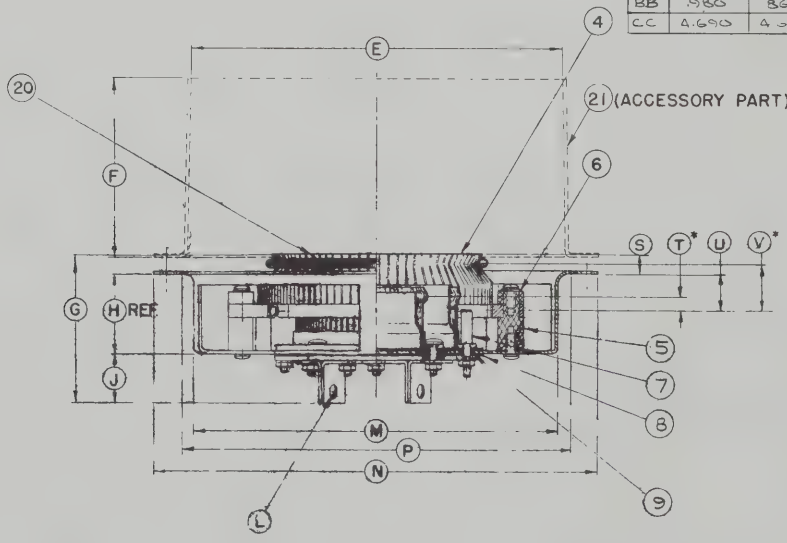
(Revised 8-15-66) © 1963, 1966 Varian

Printed in U.S.A.

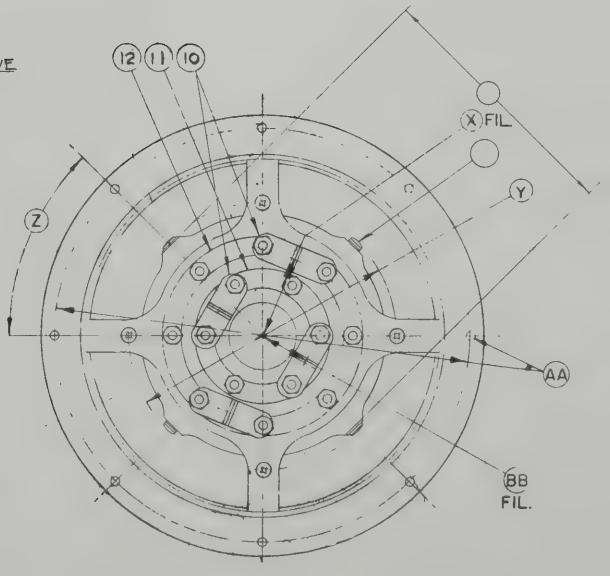
NO.	PART NO.	DESCRIPTION
1	115597	CUP, SOCKET
2	001838	OUTER FIL. COLLET
3	001837	INNER FIL. COLLET
4	115594	COLLET, GRID, ASS'M.
5	115596	INSULATOR, STAND-OFF, POST
6	115595	INSULATOR, STAND-OFF, SLEEVE
7	001825	STOP POST
8	001820	INSULATOR - FIL. COLLET
9	001834	INSULATOR - WASHER
10	115782	FILAMENT CONNECTOR
11	001808	INNER FILAMENT BUSS RING PL.
12	001809	OUTER FILAMENT BUSS RING PL.
13		6-32 UNC SCREW
20	001870	SPRING
21	115599	CHIMNEY



DIMENSION DATA			
REF.	MAX.	MIN.	NOM.
A	2.070	1.990	
B	3.320	3.240	
C	3.770	3.700	
E	7.125	7.030	
F	3.690	3.590	
G	2.835	2.710	
H	1.530	1.440	
J	.960	.890	
L	1/4 DIA. HOLE		
M	6.780	6.720	
N	8.280	8.220	
P	7.190	7.060	
S	.395	.270	
T	.285	.185	
U	.700	.580	
V	.865	.760	
X	1.620	1.500	
Y	5.030	4.976	
Z	47°	43°	
AA	*26 (147) DIA. B HOLES ON 7 3/4 DIA P.C.		
BB	.980	.860	
CC	4.690	4.520	



NOTES:
1- ALL DIMENSIONS ARE IN INCHES
2- TOLERANCES ARE NOT CUMULATIVE
3- * CONTACT SURFACES



EIMAC
Division of Varian

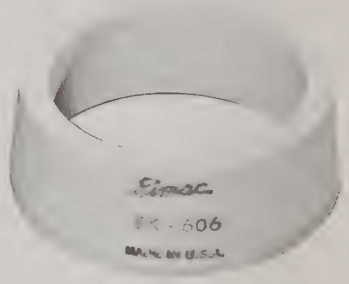
SK-606
SK-626
SK-636B

AIR-SYSTEM CHIMNEYS

The EIMAC SK-606, SK-626 and SK-636B Air-System Chimneys are intended for use with those tube and socket combinations listed below.

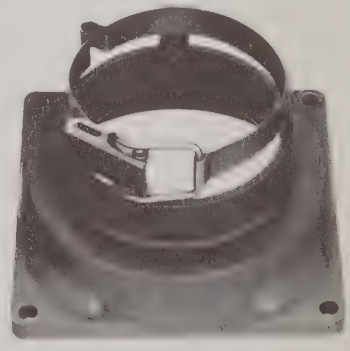
They are used to direct cooling air into the anode radiator on the tube types listed below.

The SK-636B also helps hold the tube in place by means of a clamping band around the tube's radiator.



MATERIALS

The SK-606 and SK-626 are made of high temperature ceramic. The SK-636B is molded of diallyl meta-phthalate per MIL-P-19833. The clamping band on this socket is made of beryllium copper per QQ-S-365. A neoprene "O" ring is furnished in a recess at the bottom of the socket to more effectively seal the chimney to the socket.



INSTALLATION

The SK-606 and SK-626 ceramic chimneys are installed by slipping them over the tube radiator. They are held in place by their own weight or by some suitable clamping means.

The SK-636B is secured to the chassis over the companion Air-System Socket by means of four #6 screws.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	SOCKET	TUBE
SK-606	SK-600 SK-600A SK-610 SK-640	4X150A 4X150D 4X150R 4X150S
SK-626 SK-636B	SK-620 SK-620A SK-630 SK-630A	4CX250B 4CX250F 4CX250R 7580
SK-606	SK-700 SK-710 SK-711A	4CX300A 4CX300Y

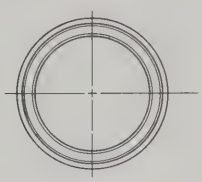
Net Weight - - - - - - - - - - - - - - SK-606 — 1.4 ounces
SK-626 — 1.4 ounces
SK-636B — 1.4 ounces

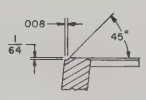
(Revised 8-15-66) © 1963, 1966 Varian

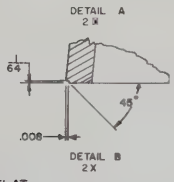
Printed in U.S.A.

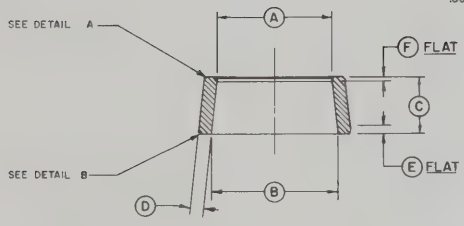
DIMENSION DATA

REF.	MIN.	MAX.	NOM.
A	1.645	1.680	
B	1.812	1.850	
C	.812	.875	
D	.156	.218	
E	109	.140	
F	046	.078	

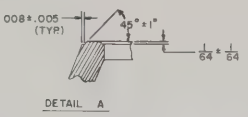


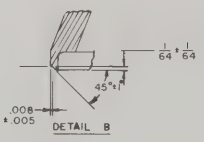






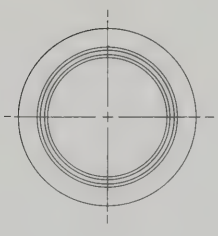
SK-606

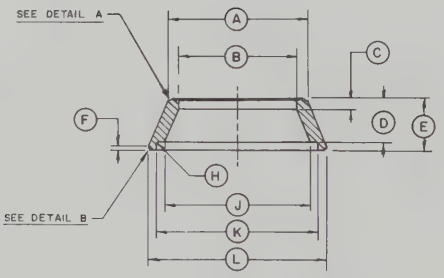




DIMENSION DATA

REF.	MIN.	MAX.	NOM.
A	1.980	2.020	
B	1.650	1.720	
C	.105	.145	
D	.573	.613	
E	.698	.738	
F	.042	.082	
H			1/32 R.
J	2.022	2.082	
K	2.300	2.362	
L	2.511	2.551	



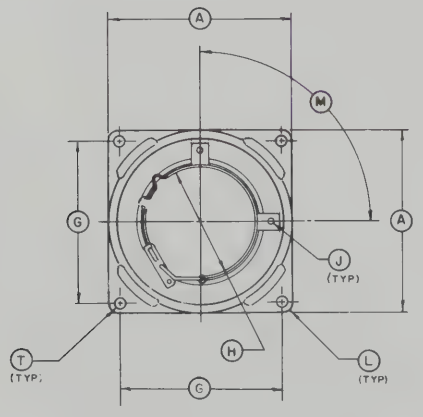


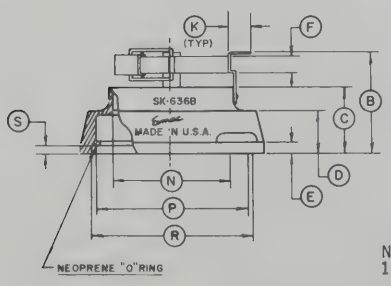
SK-626

DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.609	2.641	
B	1.607	1.677	
C	1.109	1.141	
D	560	600	
E	155	.187	
F	219	.281	
G	2.335	2.365	
H	1.580	1.620	
J	.083	.103	
K	.281	.343	
L			1/8 R
M			90°
N	1.651	1.661	
P	2.310	2.320	
R	2.492	2.502	
S	.111	121	
T	.151	161	





NOTES
1 STRAP & BRACKETS OF CLAMP - MATL BE CU PER FED SPEC QQ-C-533 SILVER PLATED AS PER QQ-S-365
2 CHIMNEY-MATL DIALLYL META-PHTHALATE PER MIL-P-19833
3 CLAMP PROVIDES A MIN. 3 LBS. RETENTION ON A 1.625 DIA. TUBE

SK-636B

EIMAC
Division of Varian

TABLE OF CONTENTS
VOLUME I

GENERAL — Effective Date

Tube Type Numbering System 4-3-58
Distributors 5-15-66
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet .....
Power Frequency Chart for Power Grid ..

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C 1-22-60
2-25A 7-1-52
2-50A 7-1-52
2-150D 12-15-65
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
2X3000F 6-1-63
250R 12-15-65
253 7-1-52
575A & 673 3-16-64
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020(100R) 2-1-52
4PR60B/8252 2-15-62
4PR65A/8187 2-15-63
4PR125A/8247 7-15-62
4PR250C/8248 6-1-66
4PR400A/8188 3-15-66
4PR1000A/8189 12-15-65
6C21 12-15-65
KY21A 7-1-66
RX21A 1-2-63

TRIODES

2C39A 10-25-62
2C39WA 2-7-58
3-400Z/8163 6-15-66
3-1000Z/8164 4-9-64
3C24 11-1-51
3CPN10A5/7815 1-1-63
3CPX100A5/7815R 1-1-63
3CV30,000A3 10-1-63
3CW5000H3 4-1-66
3CW10,000H3 7-15-66
3CW20,000A1 1-1-63
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 11-1-63
3CW30,000H3 2-1-65
3CX100A5/7289 & 3CX100F5/8250 5-1-62
3CX1000A7/8283 3-1-63
3CX2500A3/8161 12-15-64
3CX2500F3 12-15-65
3CX2500H3 3-15-66
3CX5000H3 4-1-66

TRIODES (Continued) — Effective Date

3CX10,000A1/8158 8-14-64
3CX10,000A3/8159 8-15-64
3CX10,000A7/8160 11-1-63
3CX10,000H3 3-15-66
3CX15,000A3 4-11-64
3CX15,000H3 4-1-66
3W5000A1/8240 8-15-64
3W5000A3/8242 6-1-64
3W5000F1/8241 2-18-63
3W5000F3/8243 10-20-61
3X3000A1/8238 2-18-63
3X3000A7 5-20-63
3X3000F1/8239 2-18-63
3X3000F7/8162 5-5-61
25T 12-15-65
35T 12-30-57
*35TG 5-1-62
75TH 12-15-65
75TL 1-2-52
100TH 4-1-49
100TL ..... ———
*152TH 11-25-52
*152TL 1-1-44
250TH 6-15-66
250TL 1-1-61
304TH 4-10-53
304TL 12-15-65
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
750TL 12-15-65
1000T 12-15-65
1500T 3-18-59
2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7211 9-1-64
7480 10-15-64

TETRODES – PENTODES

4-65A/8165 5-1-62
4-125A 12-15-65
4-250A/5D22 5-1-62
4-400A 9-1-65
4-1000A/8166 7-1-62
4CN15A 1-1-63
4CV8000A 11-8-62
4CV20,000A 11-8-62
4CV35,000A 5-15-66
4CV100,000C/8351 3-15-65
4CW2000A 6-15-66
4CW10,000A 4-15-63
4CW50,000C/8350 10-10-62
4CX125C,F 1-1-63
4CX250B/7203 & 4CX250F/7204 7-15-62
4CX250K/8245 & 4CX250M/8246 1-28-63

TETRODES–PENTODES (Continued) — Effective Date

4CX250R 6-16-61
4CX300A/8167 12-1-63
4CX300Y 6-15-66
4CX350A/8321 & 4CX350F/8322 6-15-65
4CX600A 5-7-63
4CX1000A/8168 6-15-66
4CX1000K/8352 1-1-64
4CX1500B 1-15-66
4CX3000A/8169 3-1-63
4CX5000A/8170 10-1-64
4CX5000R/8170W 1-1-63
4CX10,000D/8171 1-20-62
4CX15,000A/8281 6-15-66
4CX35,000C/8349 11-1-63
4W300B 6-16-60
4W20,000A/8173 4-15-64
4X150A & 4X150D 6-15-60
4X150G/8172 6-15-66
4X150R/8296 & 4X150S/8297 5-15-62
4X500A 1-1-64
4E27A/5-125B 8-15-52
5-500A 11-15-65
5CX1500A 2-15-65

OTHER PRODUCTS

VS-2, 4, 5, & 6 12-1-63
100 IG Ionization Gauge 6-15-53
Preformed Contact Finger Stock 1-15-62
HR Heat Dissipating Connectors 12-1-65
SK-300A 11-1-64
SK-306, SK-316 5-21-63
SK-400 4-1-56
SK-406, SK-416, SK-426 11-1-65
SK-410 11-15-62
SK-500 3-1-56
SK-506, SK-516 8-15-64
SK-510 5-4-63
SK-600A, SK-610A 11-1-65
SK-606, SK-626, SK-636B 5-24-63
SK-620, SK-620A 1-15-63
SK-630, SK-630A 1-18-63
SK-640 2-15-66
SK-650, SK-655 1-15-66
SK-700, SK-710, SK-606 1-20-58
SK-711A 5-9-63
SK-740 5-9-63
SK-760, SK-770 5-9-63
SK-800B, SK-806 4-9-64
SK-810, SK-806 4-9-64
SK-860, SK-870 5-9-63
SK-890, SK-806 4-9-64
SK-900, SK-906 6-1-60
SK-1300 5-9-63
SK-1306, SK-1406 5-17-63
SK-1400A, SK-1470A 5-9-63

*Not recommended for New Equipment Design.

EIMAC
Division of Varian
SAN CARLOS

8248
4PR250C
RADIAL-BEAM PULSE TETRODE MODULATOR OSCILLATOR AMPLIFIER

The EIMAC 8248/4PR250C is a pulse tetrode intended for use in pulse-modulator, switch tube, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a tantalum plate and non-emitting grids, is recommended for use in new equipments where voltages to 50 kilovolts are required.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the EIMAC SK-410 Air-System Socket.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		5.0		volts
Current	13.5		14.7	amperes
Amplification Factor (Grid to Screen)		5.2		
Direct Interelectrode Capacitances, Grounded Cathode:*				
Grid Plate		0.15		μμf
Input	11		15	μμf
Output	2.5		4.0	μμf

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommended Socket	EIMAC SK-410 Air-System Socket
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-8
Maximum Over-all Dimensions:	
Length	7.63 inches
Diameter	3.6 inches
Net Weight (tube only)	12.5 ounces

*In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	50 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	—1.0 KILOVOLT
PEAK PLATE CURRENT*	4.0 AMPERES
PLATE DISSIPATION (AVG.)	250 WATTS
SCREEN DISSIPATION (AVG.)	25 WATTS
GRID DISSIPATION (AVG.)	5 WATTS

*Note: In switch tube applications with capacitive loads, plate current may be increased to 5.5 amperes.

TYPICAL OPERATION

DC Plate Voltage	30	40	50 kV
DC Screen Voltage	1.5	1.5	1.5 kV
DC Grid Voltage	–600	–650	–700 volts
Pulse Plate Voltage	28	38	48 kilovolts
Peak Pulse Current	4.0	4.0	4.0 amps
Pulse Screen Current	0.5	0.5	0.5 amp
Pulse Grid Current	0.03	0.03	0.03 amps
Pulse Pos. Grid Voltage	130	130	130 volts
Pulse Drive Power	25	25	25 watts
Pulse Plate Input Power	120	160	200 kW
Pulse Plate Output Power	112	152	192 kW
Duty	3	3	3 percent

(Revised 6-1-66) © 1963, 1966 Varian

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS	
PEAK DC PLATE VOLTAGE	35 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	—1.0 KILOVOLT
PEAK CATHODE CURRENT**	5.5 AMPERES
PLATE DISSIPATION (AVG.)	250 WATTS
SCREEN DISSIPATION (AVG.)	25 WATTS
GRID DISSIPATION (AVG.)	5 WATTS

*When used as a RF Plate-and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid over-heating this element during the inter-pulse periods.

TYPICAL OPERATION			
Pulse Plate Voltage	25	30	35 kV
Pulse Screen Voltage	1.5	1.5	1.5 kV
DC Grid Voltage	–650	–675	–700 volts
Pulse Plate Current**	940	925	900 mA
Pulse Screen Current	30	30	30 mA
Pulse Grid Current	6	6	6 mA
Peak RF Grid Voltage	780	805	830 volts
Pulse Drive Power	4.7	5	4.5 watts
Pulse Plate Input Power	23.5	27.7	31.5 kW
Pulse Plate Output Power	19.0	23.0	26.5 kW
Duty	5.5	5	5 percent

RADIO FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS	
DC PLATE VOLTAGE	25 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	—1.0 KILOVOLT
PEAK CATHODE CURRENT**	5.5 AMPERES
PLATE DISSIPATION (AVG.)	250 WATTS
SCREEN DISSIPATION (AVG.)	25 WATTS
GRID DISSIPATION (AVG.)	10 WATTS

TYPICAL OPERATION		
DC Plate Voltage	20	25 kV
DC Screen Voltage	1.5	1.5 kV
DC Grid Voltage	–600	–650 volts
Pulse Plate Current**	940	940 mA
Pulse Screen Current	30	30 mA
Pulse Grid Current	6	6 mA
Peak RF Grid Voltage	730	780 volts
Pulse Drive Power	4.4	4.7 watts
Pulse Plate Input Power	18.8	23.5 kW
Pulse Plate Output Power	15.0	19.0 kW
Duty	6	5.5 percent

**The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting — The 4PR250C must be operated vertically base up or down. The SK-410 Air-System Socket may be used to aid in directing air to the metal base shell.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers. The tube must be protected from severe shock and vibration.

Cooling — Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200°C. In all classes of operation it is recommended that a heat-radiating connector, the EIMAC HR-8 or equivalent, be installed on the anode terminal, and that a socket be employed which provides for proper base seal cooling. When the EIMAC 4PR250C is operated at dc or low frequencies in an EIMAC SK-410 Air System Socket, the minimum airflow requirements to maintain seal temperatures at 200°C in 25°C inlet air are approximately 2 to 5 cfm.

When the EIMAC 4PR250C is used as a pulsed-amplifier or oscillator at frequencies above 30 MHz, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adquacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage — For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR250C is used in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tubes peak-current capabilities are to be realized.

Element Dissipation — Under normal operating conditions, the average plate dissipation of the 4PR250C should not be allowed to exceed 250 watts. Dissipation in excess of this maximum rating is permissible for short periods of time, such as during tuning procedures.

The average power dissipated by the screen-grid and the control-grid must not exceed 25 watts and 5 watts, respectively.

Cut-Off Characteristics — The Plate Current Cut-Off Characteristics of the 4PR250C are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

Each 4PR250C is tested to insure proper cut-

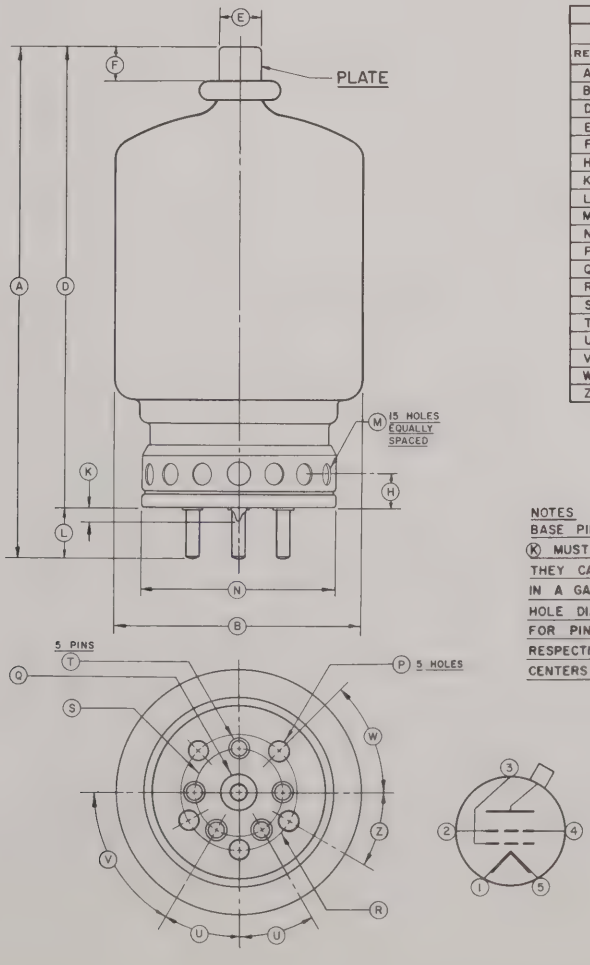
off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 50 kV, a screen voltage of 1.5 kV, with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 675 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between —500 volts and —650 volts.

Pulse-Modulator Service — The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate wave form is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

As a switch tube with capacitive loading, as in a floating deck modulator, the peak plate current during the pulse may reach 5.5 amperes. This can be tolerated since under capacitive load conditions the plate voltage at the beginning of the pulse is equal to applied dc voltage, with high plate current and low screen grid current. As the load is charged, plate current falls while screen current rises. Protection for the screen must be provided to limit dissipation at the end of the pulse.

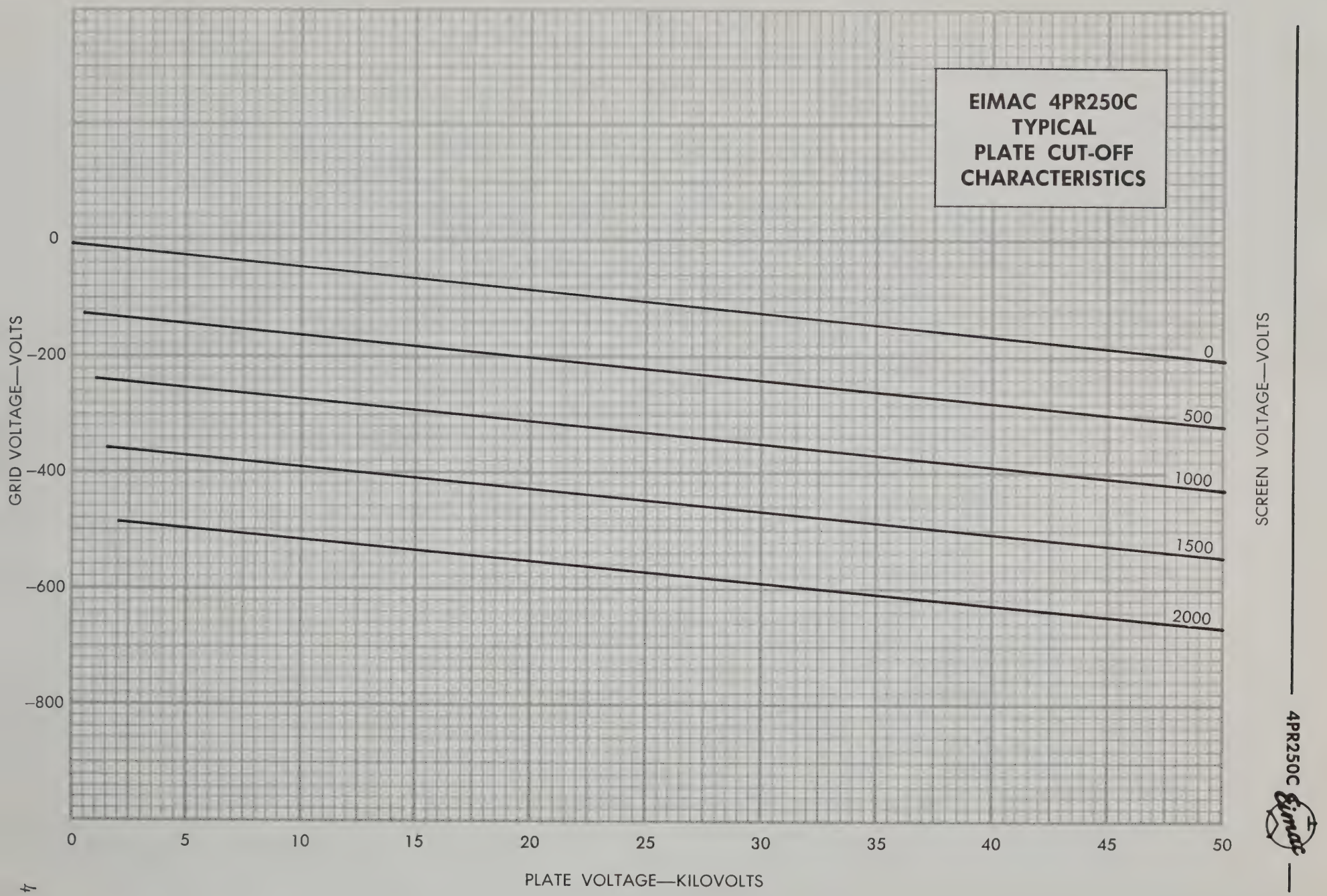
X-Ray Precautions — As with any tube operating at these high voltages and currents, x-rays will be generated in dangerous quantities. Adequate shielding must be provided in any equipment to protect personnel protection.

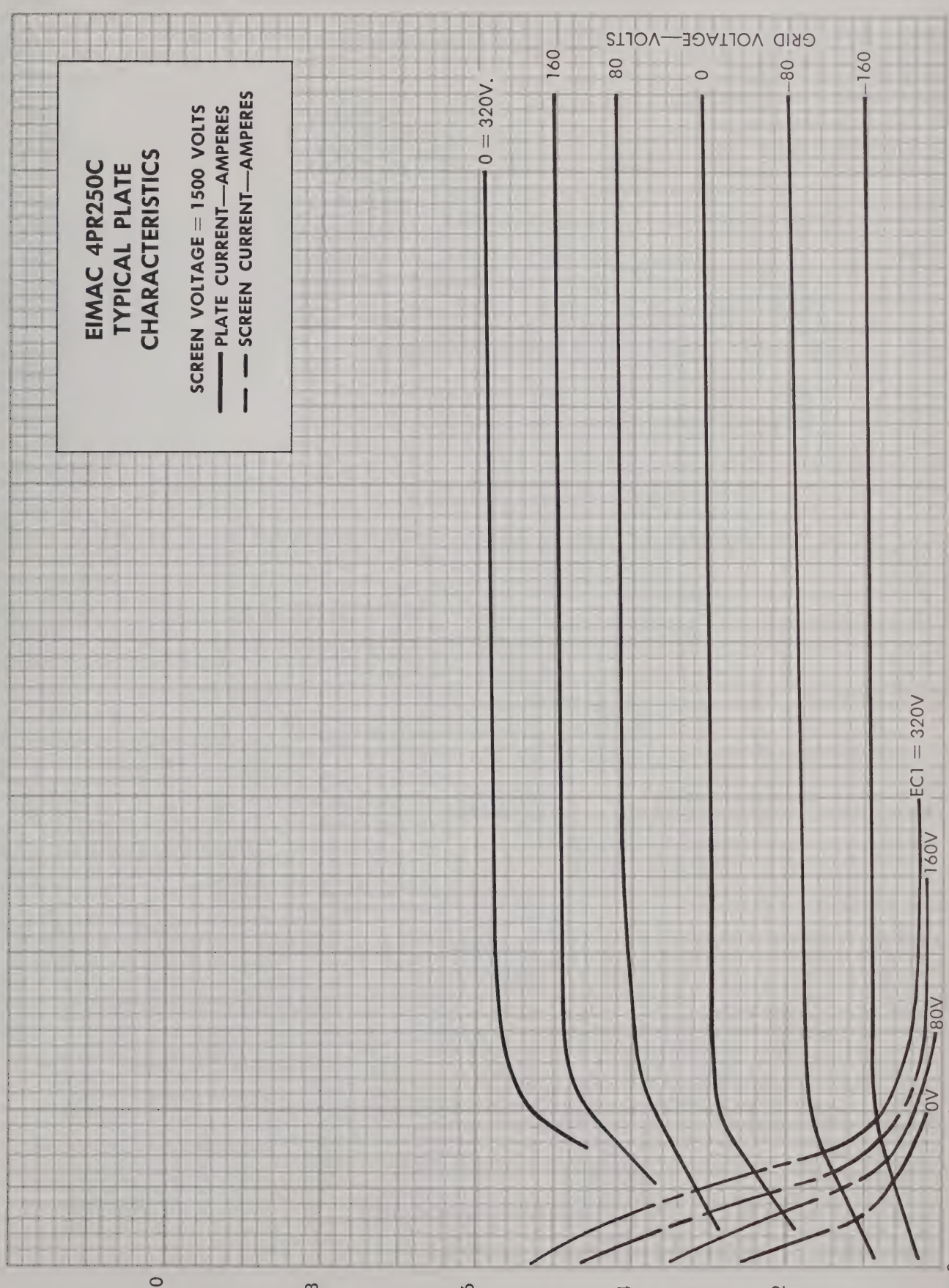
Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

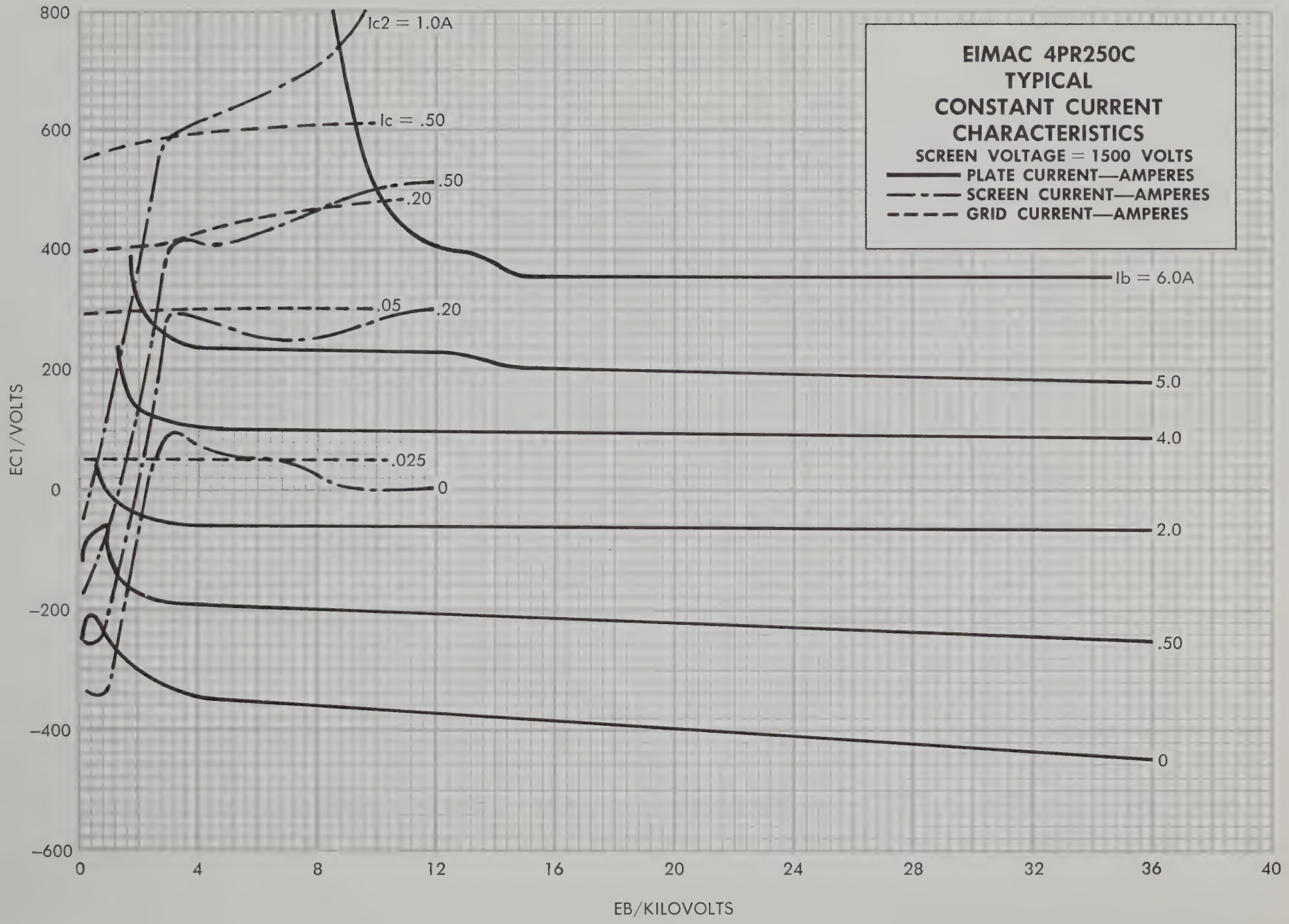


DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX	NOM.
A	7-1/16	7-5/8	
B	3-13/32 D.	3-15/32 D.	
D	6-5/16 D.	6-13/16 D.	
E	.557 D.	.567 D.	
F	15/32	17/32	
H	3/8	1/2	
K		1/4 NOTE 1	
L	11/16	7/8	
M	7/32 D.	9/32 D.	
N		2-3/4 D.	
P	9/32 D.	11/32 D.	
Q	15/32 D.	17/32 D.	
R	1-19/32 D.	1-21/32 D.	
S			1-1/4 D. NOTE 1
T	185 D.	191 D. NOTE 1	
U			30° NOTE 1
V			60° NOTE 1
W			45°
Z			30°

NOTES
BASE PINS (T) AND TUBULATION (K) MUST BE ALIGNED SO THAT THEY CAN BE FREELY INSERTED IN A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 FOR PINS AND TUBULATION RESPECTIVELY LOCATED ON TRUE CENTERS DEFINED BY (S) (U) (V).


EIMAC 4PR250C
TYPICAL
PLATE CUT-OFF
CHARACTERISTICS
GRID VOLTAGE—VOLTS
0
−200
−400
−600
−800
0
500
1000
1500
2000
SCREEN VOLTAGE—VOLTS
0
5
10
15
20
25
30
35
40
45
50
PLATE VOLTAGE—KILOVOLTS


EIMAC 4PR250C
TYPICAL PLATE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID VOLTAGE—VOLTS
0 = 320V.
160
80
0
-80
-160
EC1 = 320V
160V
80V
0V
CURRENT—AMPERES
PLATE VOLTAGE/KILOVOLTS
0
2
4
6
8
10
12
14
16


EIMAC 4PR250C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
Ic2 = 1.0A
Ic = .50
.50
.20
.05
.20
.025
0
Ib = 6.0A
5.0
4.0
2.0
.50
0
800
600
400
200
0
−200
−400
−600
EC1/VOLTS
0
4
8
12
16
20
24
28
32
36
40
EB/KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

KY21A

GRID-CONTROLLED MERCURY-VAPOR RECTIFIER

The EIMAC KY21A is a grid-controlled mercury vapor-rectifier incorporating features which enable it to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The oxide-coated, edge-wise-wound, shielded ribbon filament, provides a large emission reserve and long life.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated	
Voltage	2.5 volts
Current	10 amperes
Tube Voltage Drop (approx.)	10 volts
Ionization Time (approx.)	10 μsec
Deionization Time (approx.)	1000 μsec

MECHANICAL

Base	Medium, 5-pin, #A5-11
Recommended Socket	E. F. Johnson #122-225
Maximum Overall Dimensions:	
Length	8.0 inches
Diameter	$2\frac{1}{16}$ inches
Net Weight	4 ounces
Shipping Weight	3 pounds

MAXIMUM RATINGS (Single Tube)

PEAK INVERSE ANODE VOLTAGE*	11,000 VOLTS
PEAK ANODE CURRENT	3 AMPERES
AVERAGE ANODE CURRENT	.75 AMPERES
SUPPLY FREQUENCY	150 CPS
CONDENSED-MERCURY TEMPERATURE RANGE**	20-60° CENTIGRADE

*Temperatures in excess of 60°C limit the peak-inverse rating to 5500 volts with a corresponding reduction in permissible RMS supply voltages to one-half those listed in the table.
**Operation at 40° plus or minus 5° is recommended.

APPLICATION

MECHANICAL

Mounting — The KY21A must be mounted vertically, base down. In order to carry the ten amperes of filament current the adjacent pins have been connected in parallel within the base. Similar connections should be made in the socket.

Cooling — Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury in the KY21A should be kept within the ranges given under "MAXIMUM RATING."

This temperature should be maintained at 40° ±5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

ELECTRICAL

Filament Voltage — For maximum tube life, the filament voltage as measured directly at

(Revised 7-1-66) © 1953, 1966 Varian

Printed in U.S.A.

the filament pins, should be held at the rated value of 2.5 volts. Unavoidable variations in filament voltage must be kept within the range of 2.4 to 2.6 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

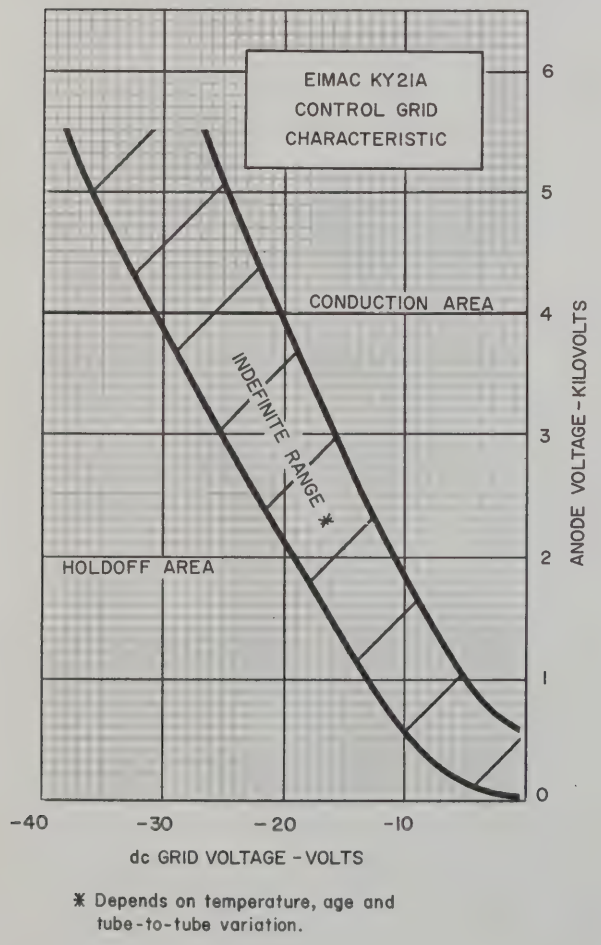
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament of the KY21A should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

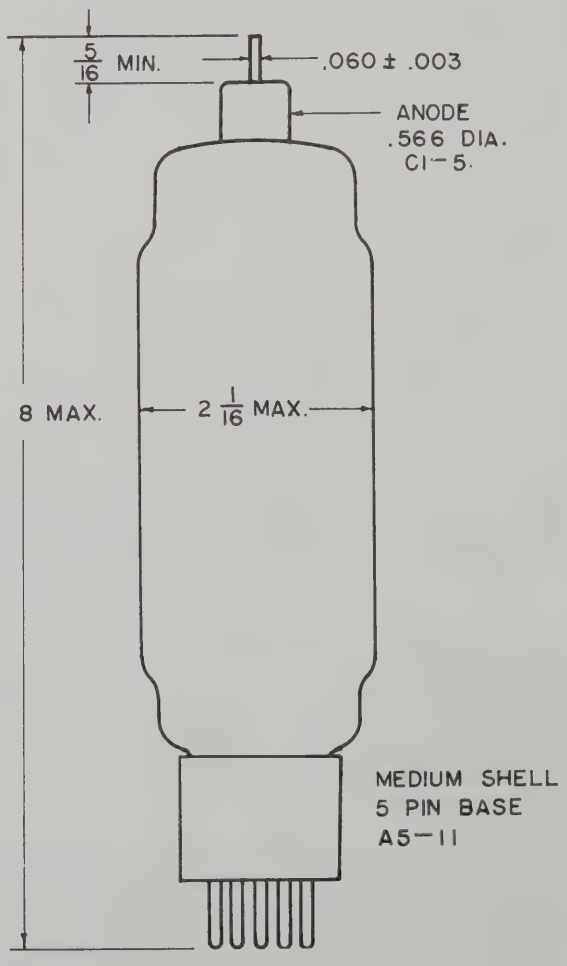
When it is necessary to use a shield around the KY21A care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a KY21A is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

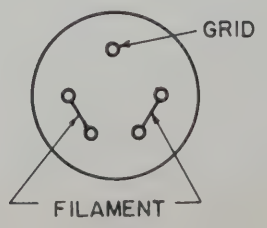
Shielding — Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the KY21A should be isolated from such fields as exist around a transmitter or other similar equipment.

Grid Circuit — The KY21A is prevented from conducting by placing a negative potential on the grid. The relationship between negative grid control voltage and anode voltage is shown in the characteristic curve below.



* Depends on temperature, age and tube-to-tube variation.





NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with EIMAC Division of Varian.

EIMAC
Division of Varian

8163
3-400Z

HIGH-MU POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	14.5	amperes
Amplification Factor (Average)	200	
Interelectrode Capacitances (Average):*		
Grid-Filament	7.4	μμf
Grid-Plate	4.1	μμf
Plate-Filament	0.07	μμf
Frequency for Maximum Ratings	110	MHz

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-all Dimensions:	
Height	5.25 inches
Diameter	3.57 inches
Net Weight	7 ounces

*In Shielded Fixture

(Revised 6-15-66) © 1961, 1966 Varian

Printed in U.S.A.

R-F LINEAR AMPLIFIER GROUNDED-GRID, CLASS-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Single-Tone Conditions)

DC Plate Voltage	3000 volts
Zero-Sig DC Plate Current*	100 ma
Max-Sig DC Plate Current	333 ma
Max-Sig DC Grid Current	120 ma
Driving Impedance	122 ohms
Resonant Load Impedance	4750 ohms
Max-Sig Driving Power	32 watts
Peak Envelope Plate Output Power	655 watts

TYPICAL OPERATION (Minimum Distortion Products)

DC Plate Voltage	2000 volts
Zero-Sig DC Plate Current*	62 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	148 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	87 ma
Peak Envelope Useful Output Power	445 watts
Resonant Load Impedance	2750 ohms
Intermodulation Distortion Products	—40 db

TYPICAL OPERATION (Minimum Distortion Products at 1 KW PEP Input)

DC Plate Voltage	2500 volts
Zero-Sig DC Plate Current*	73 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	142 ma
Two-Tone DC Plate Current	274 ma
Two-Tone DC Grid Current	82 ma
Peak Envelope Useful Output Power	560 watts
Resonant Load Impedance	3450 ohms
Intermodulation Distortion Products	—35 db

TYPICAL OPERATION (Minimum Distortion Products at 1500 Volts Plate Voltage)

DC Plate Voltage	1500 volts
Zero-Sig DC Plate Current*	46 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	163 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	92 ma
Peak Envelope Useful Output Power	300 watts
Resonant Load Impedance	1620 ohms
Intermodulation Distortion Products	—37 db

A-F AMPLIFIER OR MODULATOR, CLASS-B

MAXIMUM RATINGS (PER TUBE)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

DC Plate Voltage	3000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	200 ma
Max-Sig DC Plate Current	666 ma
Max-Sig DC Grid Current	240 ma
Driving Power	26 watts
Peak A-F Driving Voltage (per tube)	88 volts
Load Resistance, Plate-to-Plate	9500 ohms
Max-Sig Plate Output Power	1310 watts

R-F POWER AMPLIFIER OR OSCILLATOR, CLASS-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	0.350 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	333 ma
DC Grid Voltage	—75 volts
DC Grid Current	130 ma
Peak R-F Grid Voltage	187 volts
Grid Driving Power	25 watts
Plate Output Power	730 watts

R-F POWER AMPLIFIER PLATE-MODULATED

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.275 AMP
PLATE DISSIPATION	270 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	245 ma
DC Grid Voltage	—90 volts
DC Grid Current	100 ma
Peak R-F Grid Voltage	185 volts
Grid Driving Power	18 watts
Plate Output Power	550 watts

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

*Approximate Value

APPLICATION

Mounting — The 3-400Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling — Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an inlet air temperature of 55°C. At higher inlet air temperatures, higher altitudes, or at frequencies above 30 MHz, the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead. In all cases, air flow rates in excess of the minimum requirements will prolong tube life.

Class-C Operation — Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

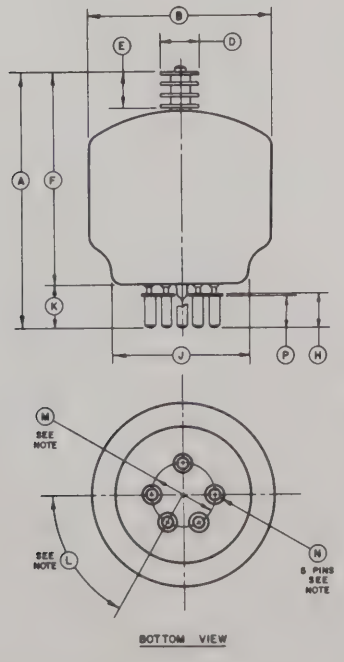
Filament Operation—The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

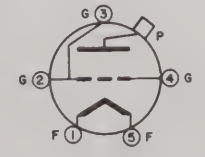
Intermodulation Distortion — Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

Input Circuit — When the 3-400Z is operated as a grounded-grid r-f amlpifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

3-400Z OUTLINE DRAWING AND PIN CONNECTIONS

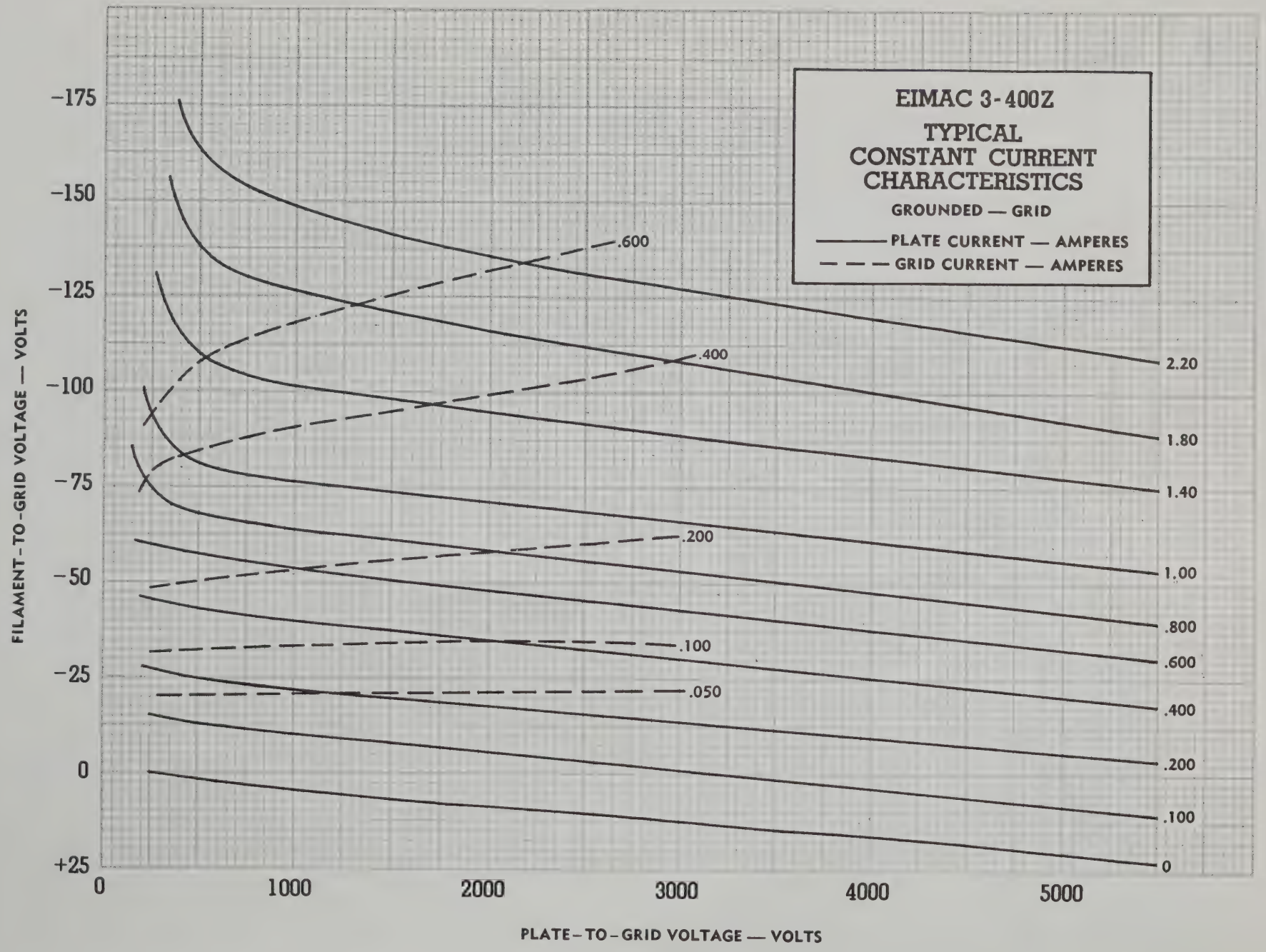


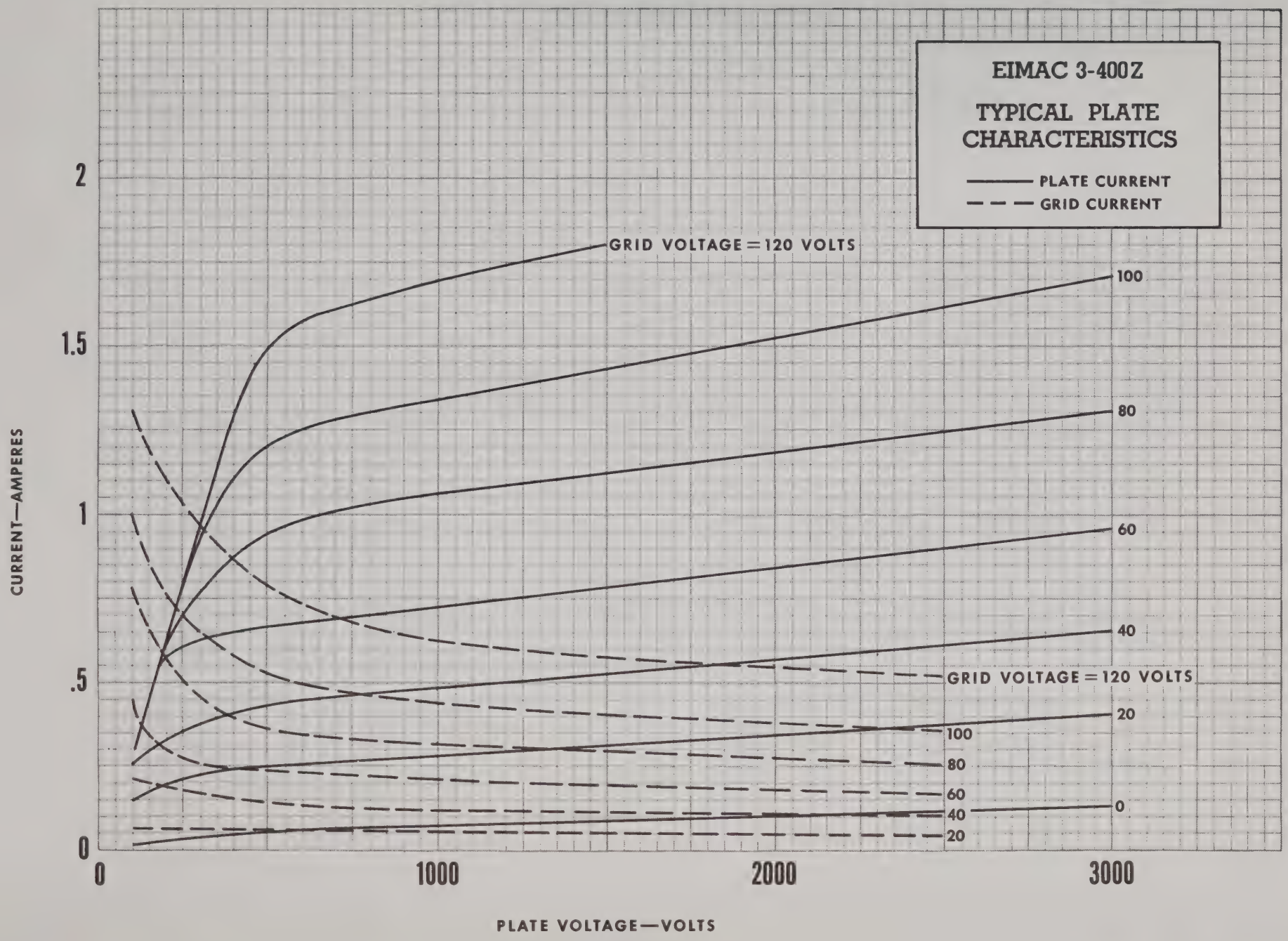


NOTE:
BASE PINS (N) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA'S. OF .204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMS. (L) & (M).

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4-3/4	5-1/4	
B		3-9/16 D.	
D	.745 D.	.755 D.	
E	.540	.660	
F	3-15/16	4-7/16	
H	9/16	11/16	
J		2-1/2 D.	
K			13/16
L			60° TYP.
M			1-1/4 D. P.C.
N	.185 D.	.191 D.	
P	1/2	5/8	


EIMAC 3-400Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED — GRID
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
FILAMENT-TO-GRID VOLTAGE — VOLTS
−175
−150
−125
−100
−75
−50
−25
0
+25
0
1000
2000
3000
4000
5000
PLATE-TO-GRID VOLTAGE — VOLTS
.600
.400
.200
.100
.050
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0


EIMAC 3-400Z
TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
0
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
0
2
1.5
1
.5
0
1000
2000
3000
CURRENT—AMPERES
PLATE VOLTAGE—VOLTS

EIMAC
Division of Varian

3CW10,000H3

INDUSTRIAL MEDIUM-MU

WATER-COOLED POWER TRIODE

The EIMAC 3CW10,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 10 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 30 kilowatts is permissable up to 90 Megahertz. Plentiful reserve emission is available from its 560 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		Volts
Current	73		78	Amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Input			53	$\mu\mu$f
Output			1.5	$\mu\mu$f
Grid-Plate			25	$\mu\mu$f
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperature	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	10 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Revised 7-15-66) © 1966 Varian

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR
Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 Volts
DC PLATE CURRENT	3.0 Amps
DC GRID VOLTAGE	—1000 Volts
DC GRID CURRENT	0.5 Amp
PLATE INPUT POWER	30 kW
PLATE DISSIPATION	10 kW

TYPICAL OPERATION*

DC Plate Voltage	7000	9000 Volts
DC Plate Current	2.88	2.9 Amps
DC Grid Voltage	—700	—900 Volts
DC Grid Current	0.180	0.185 Amps
Peak Positive Grid Voltage	250	250 Volts
Driving Power	170	215 Watts
Plate Input Power	20.15	26.1 kW
Plate Dissipation	5.15	5.5 kW
Plate Output Power	15	20.6 kW
Approximate Load Impedance	1120	1470 Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

For the 3CW10,000H3 the rated filament voltage is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.5 ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.25 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 150 watts.

Plate Operation

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CW10,000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 15°C temperature rise of water from inlet to outlet.

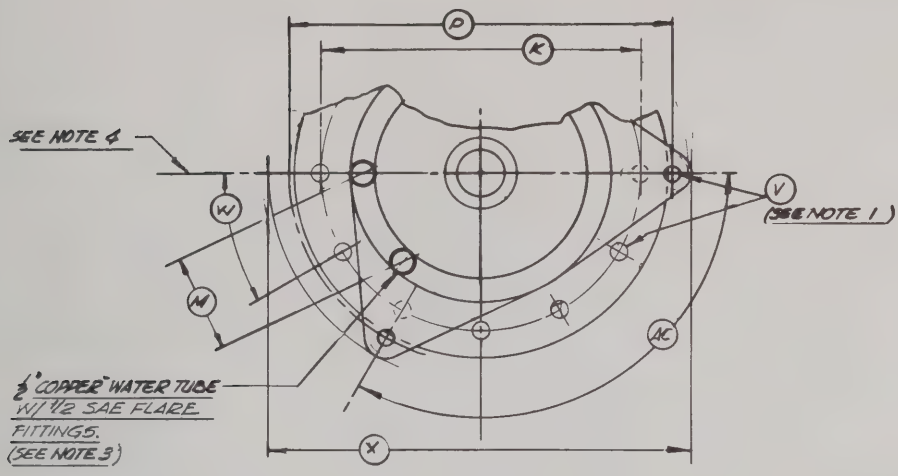
MINIMUM WATER-COOLING REQUIREMENT

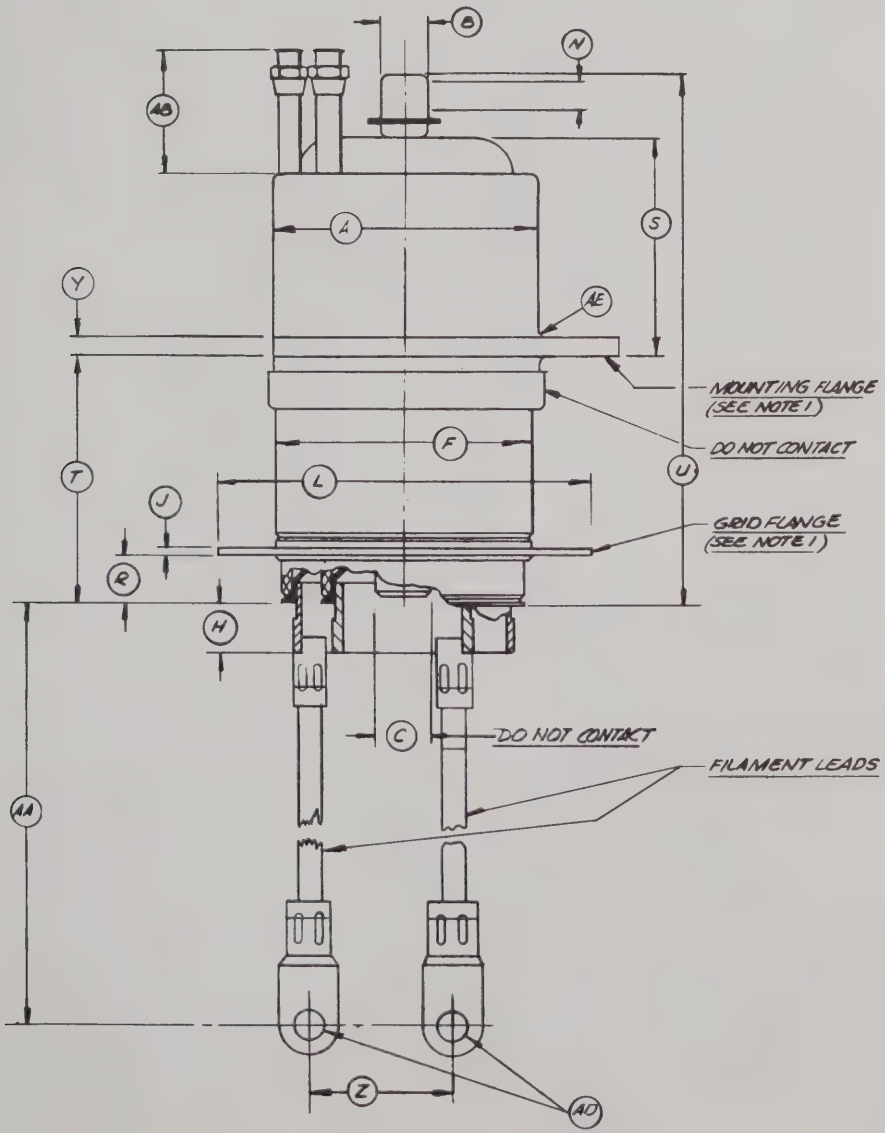
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
8	3.2	5.5
10	4.4	8.1
12	5.8	13.4

Additional stem cooling air must be provided. 8 CFM of air directed against the center filament contact ring ½ inch below the outer filament contact ring by a 1½ inch I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

Special Applications

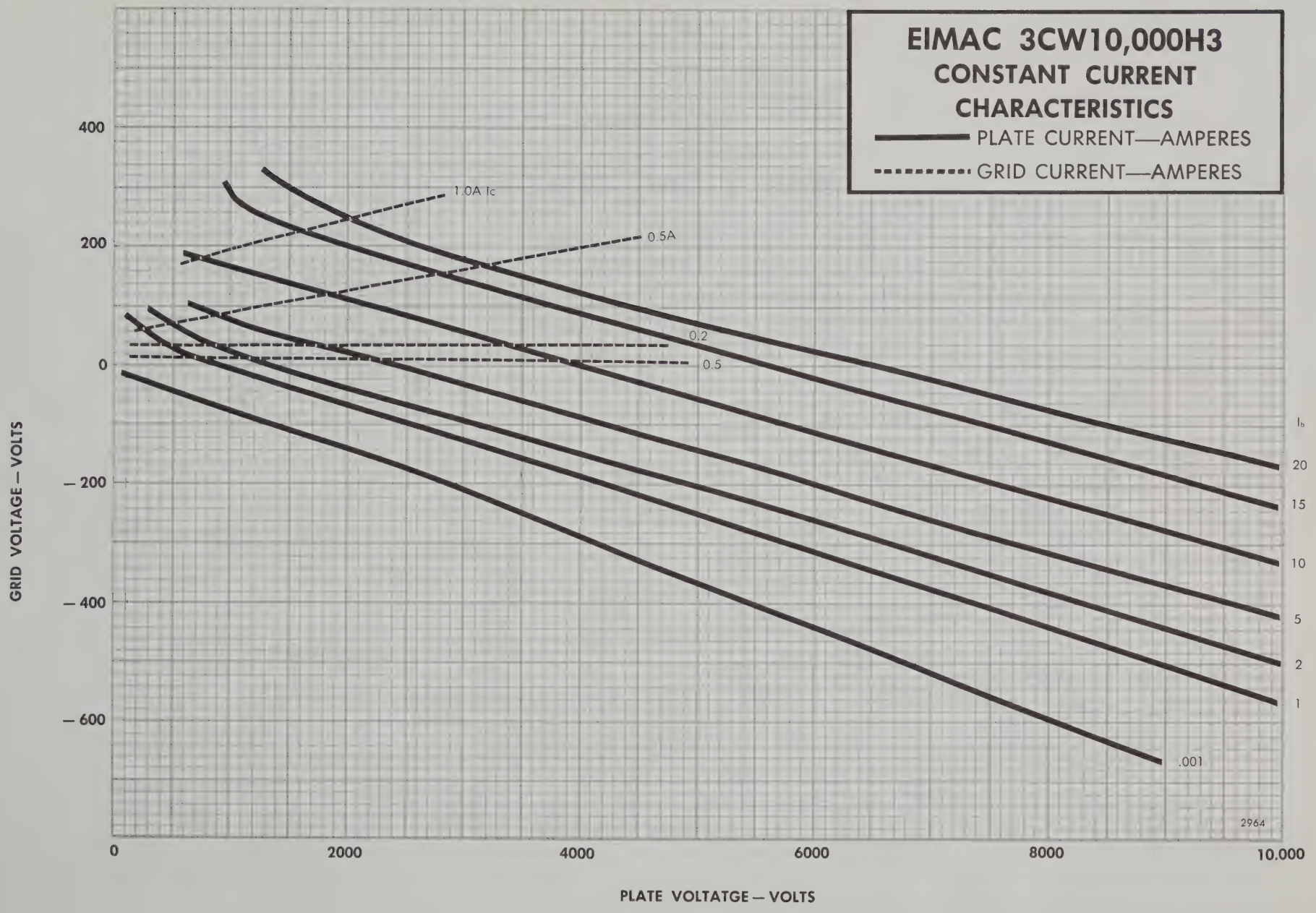
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	3.525	3.725	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.220	5.280	
R	.800	.860	
S	3.000	3.250	
T	4.250	4.400	
U	8.500	8.900	
V			.250
W	29°	31°	
X	5.950	6.050	
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390
AE			.062R

NOTES:
1. 12 MOUNTING HOLES IN EACH FLANGE.
2. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW10,000H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT—AMPERES
GRID CURRENT—AMPERES
1.0A Ic
0.5A
0.2
0.5
.001
Ib
20
15
10
5
2
1
2964
400
200
0
— 200
— 400
— 600
GRID VOLTAGE — VOLTS
0
2000
4000
6000
8000
10,000
PLATE VOLTATGE — VOLTS

EIMAC
A Division of Varian Associates

3CW20,000A3

WATER-COOLED MEDIUM-MU POWER TRIODE

The EIMAC 3CW20,000A3 is a ceramic and metal power triode intended primarily for use as a power oscillator in industrial-heating applications. It is also recommended for use as a grounded-grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amperes
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Input	48		58	$\mu\mu$f
Output	1.2		1.5	$\mu\mu$f
Feedback	30		38	$\mu\mu$f
Frequency for Maximum Ratings			140	MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1300
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	11.4 inches
Diameter	4.7 inches
Net Weight	12 pounds

RADIO-FREQUENCY INDUSTRIAL OSCILLATOR

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	20 KW
GRID DISSIPATION	250 WATTS

TYPICAL OPERATION, Optimum Load

DC Plate Voltage	6000	7000 volts
DC Grid Voltage	—575	—670 volts
DC Plate Current	4.0	4.0 amps
DC Grid Current	610	670 mA
Plate Input Power	24	28 kW
Plate Output Power	18.9	22.4 kW

RADIO-FREQUENCY POWER AMPLIFIER

Grounded-Grid, Class C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	20 KW
GRID DISSIPATION	250 WATTS

TYPICAL OPERATION

DC Plate Voltage	6000	7000 volts
DC Grid Voltage	—535	—625 volts
DC Plate Current	4.0	4.0 amps
DC Grid Current	545	530 mA
Driving Power	3700	4100 watts
Plate Output Power	20.5	24.5 kW

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Revised 6-1-66) © 1963, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER
PLATE-MODULATED
Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 VOLTS
DC PLATE CURRENT	3.0 AMPS
PLATE DISSIPATION	13.5 KW
GRID DISSIPATION	250 WATTS

TYPICAL OPERATION

DC Plate Voltage	4000	5000 volts
DC Grid Voltage	–480	–600 volts
DC Plate Current	3.0	3.0 amps
DC Grid Current	660	550 mA
Driving Power	530	515 watts
Plate Output Power	9.7	12.4 kW

RADIO-FREQUENCY
LINEAR AMPLIFIER
Grounded-Grid, Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	20 KW
GRID DISSIPATION	250 WATT

*Adjust to give specified zero-signal dc plate current

TYPICAL OPERATION

DC Plate Voltage	6000	7000 volts
DC Grid Voltage*	–270	–325 volts
Zero-Sig Plate Current	500	500 mA
Max-Sig DC Plate Current	4.0	4.0 amps
Max-Sig DC Grid Current	300	250 mA
Peak RF Grid Voltage	540	585 volts
Driving Power	1900	2050 watts
Plate Output Power	18	20 kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

MECHANICAL

Mounting — The 3CW20,000A3 must be operated vertically, base down or up. The tube must be protected from severe vibration and shock.

Cooling — The anode of the 3CW20,000A3 is cooled by circulating water through the integral anode-water jacket. The table below lists minimum water-flow rates at various plate dissipation levels.

MINIMUM COOLING WATER-FLOW REQUIREMENTS

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
10	6.3	4.9
15	9.0	9.2
20	12.0	15.0

Since power dissipated by the filament represents 750 watts and grid dissipation can reach 250 watts, 1000 watts has been added to anode dissipation in preparing this tabulation.

The cooling table assumes that the maximum outlet-water temperature will be below 70°C to preclude "spot" boiling. Further, the inlet-water temperature must not exceed 60°C. In all cases, maximum system water pressure must be below 50 pounds per square inch. Water flow and air flow must be started before applying any voltages to the tube and may be stopped simultaneously with the removal of tube voltages. Suitable flow and temperature interlocks should be provided to protect the tube from inadequate flow rates.

Base cooling is accomplished by a stream of air directed at the center of the socket and tube base from a duct or nozzle approximately two inches in diameter, not more than 5 inches from the socket. A minimum of 30 CFM is required at sea level.

ELECTRICAL

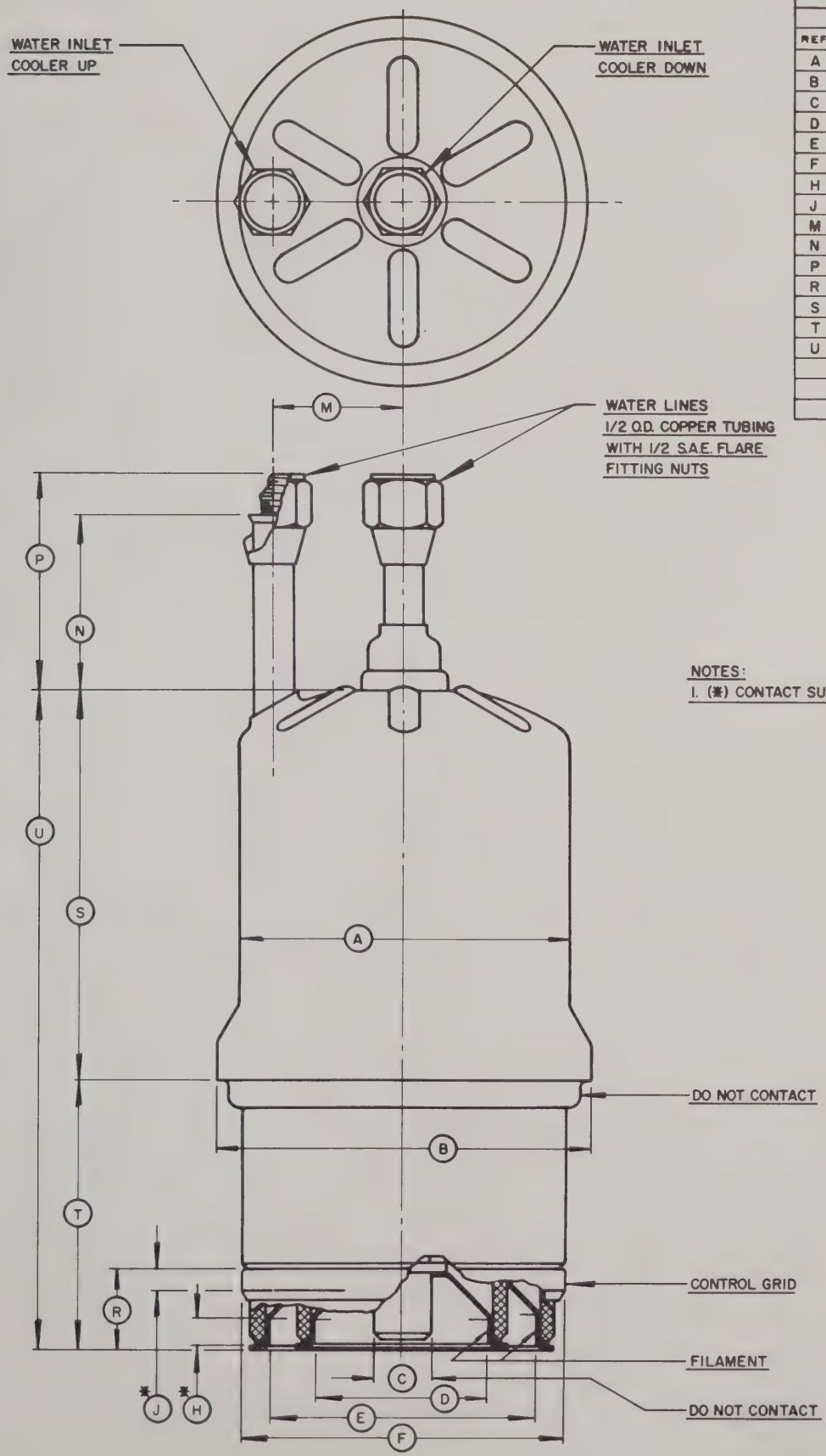
Filament — The rated filament voltage for the 3CW20,000A3 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

Grid Dissipation — The rated grid dissipation of the 3CW20,000A3 is 250 watts. Grid dissipation is the approximate product of dc grid current and peak positive grid voltage. In equipment where plate loading varies widely, such as radio-frequency heating oscillators, care should be taken to insure that grid dissipation does not exceed the 250 watt maximum.

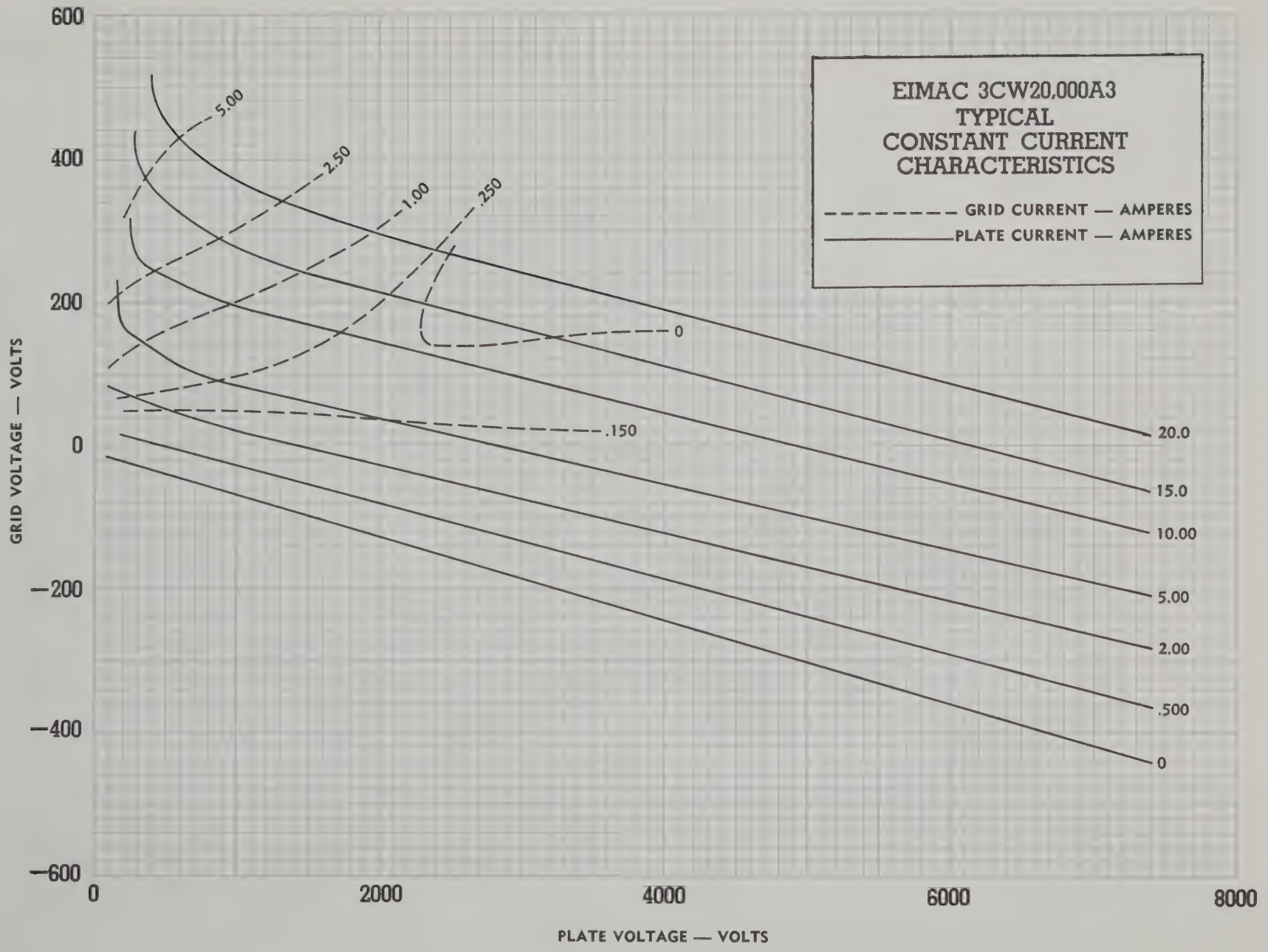
Plate Operation — Plate input is limited to 28 kilowatts in Class-C and Class-AB applications. In Class-C, plate-modulated applications, this rating is reduced to 15 kilowatts. The 20 kilowatt anode dissipation capability provides a large margin of safety in most applications.

Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4.094	4.156	
B	4.594	4.656	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
H	.188		
J	.188		
M	1.500	1.750	
N	1.937	2.187	
P	2.312	2.812	
R	.986	1.050	
S	4.780	5.025	
T	3.350	3.650	
U	8.125	8.625	



NOTES:
1. (*) CONTACT SURFACE


EIMAC 3CW20,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
5.00
2.50
1.00
.250
0
.150
20.0
15.0
10.00
5.00
2.00
.500
0
600
400
200
0
−200
−400
−600
0
2000
4000
6000
8000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

8238
3X3000A1

LOW-MU TRIODE

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA



The Eimac 8238/3X3000A1 is a low-mu forced-air cooled power triode intended for use as an audio amplifier or modulator. The maximum rated plate dissipation is 3000 watts.

Two 3X3000A1's in class-AB_1 audio service will deliver up to 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

The 3X3000A1 is provided with a low inductance, coaxial filament structure. A water-cooled version, the 3W5000A1, rated at 5 kW plate dissipation, is also available.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor	4.4		5.6	
Direct Interelectrode Capacitances (Average)				
Grid-Plate		17		uufd
Grid-Filament		29		uufd
Plate-Filament		2.5		uufd
Transconductance (I_b = 1.0 amp., E_b = 3000. V)		11,000		umhos
Maximum Frequency			75	Mc

MECHANICAL

Base	See outline drawing
Mounting Position	Vertical, base down or up
Cooling	Forced air
▶ Maximum Temperatures:	
Grid and Filament Seals	175°C
Anode Cooler Core	250°C
Maximum Diameter	4.16 inches
Maximum Height	8.59 inches
Net Weight	6.25 pounds
Shipping Weight	16 pounds

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	6000 MAX.	VOLTS
DC PLATE CURRENT	2.5 MAX.	AMPERES
PLATE DISSIPATION	3000 MAX.	WATTS
GRID DISSIPATION	50 MAX.	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ±15%. Effective grid-circuit resistance must not exceed 200,000 ohms.

**At maximum signal without negative feedback.

TYPICAL OPERATION (Sinusoidal wave, two tubes)
Class AB_1

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage (Approx)*	-860	-1080	-1300	volts
Zero-Signal DC Plate Current	500	400	335	mA
Max-Signal DC Plate Current	3.00	2.80	2.65	amps
Effective Load, Plate-to-Plate	2160	3320	4560	ohms
Peak AF Grid Input Voltage (per tube)	760	995	1250	volts
Max-Signal Driving Power	0	0	0	watts
Max-Signal Plate Input Power	12,000	14,000	16,000	watts
Max-Signal Plate Dissipation (per tube)	3000	3000	3000	watts
Max-Signal Plate Output Power	6000	8000	10,000	watts
Total Harmonic Distortion**	1.8	2.6	2.1	percent

(Effective 2-18-63) © Copyright 1952, 1953, 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

▶ Change from data sheet dated 2-1-52

APPLICATION

MECHANICAL

Mounting: The 3X3000A1 must be mounted vertically with its base up or down at the convenience of the designer. The filament connections should be made through spring collets and care must be taken not to impart strain to the terminals or base assembly.

The tube must be protected from severe shock and vibration during shipment and operation.

Cooling: Sufficient forced air cooling must be provided to maintain seal and anode core temperature at 175°C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

The table below lists minimum air-flow requirements to maintain tube temperatures below 175°C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 25° C and sea level. A separate supply of approximately six cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem between the filament seals.

	MINIMUM COOLING AIR-FLOW REQUIREMENTS			
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)
1000	14	0.1	20	0.1
2000	37	0.3	61	0.8
3000	74	1.0	122	3.0

Note:
An extra 425 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for grid and filament dissipation.

For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

ELECTRICAL

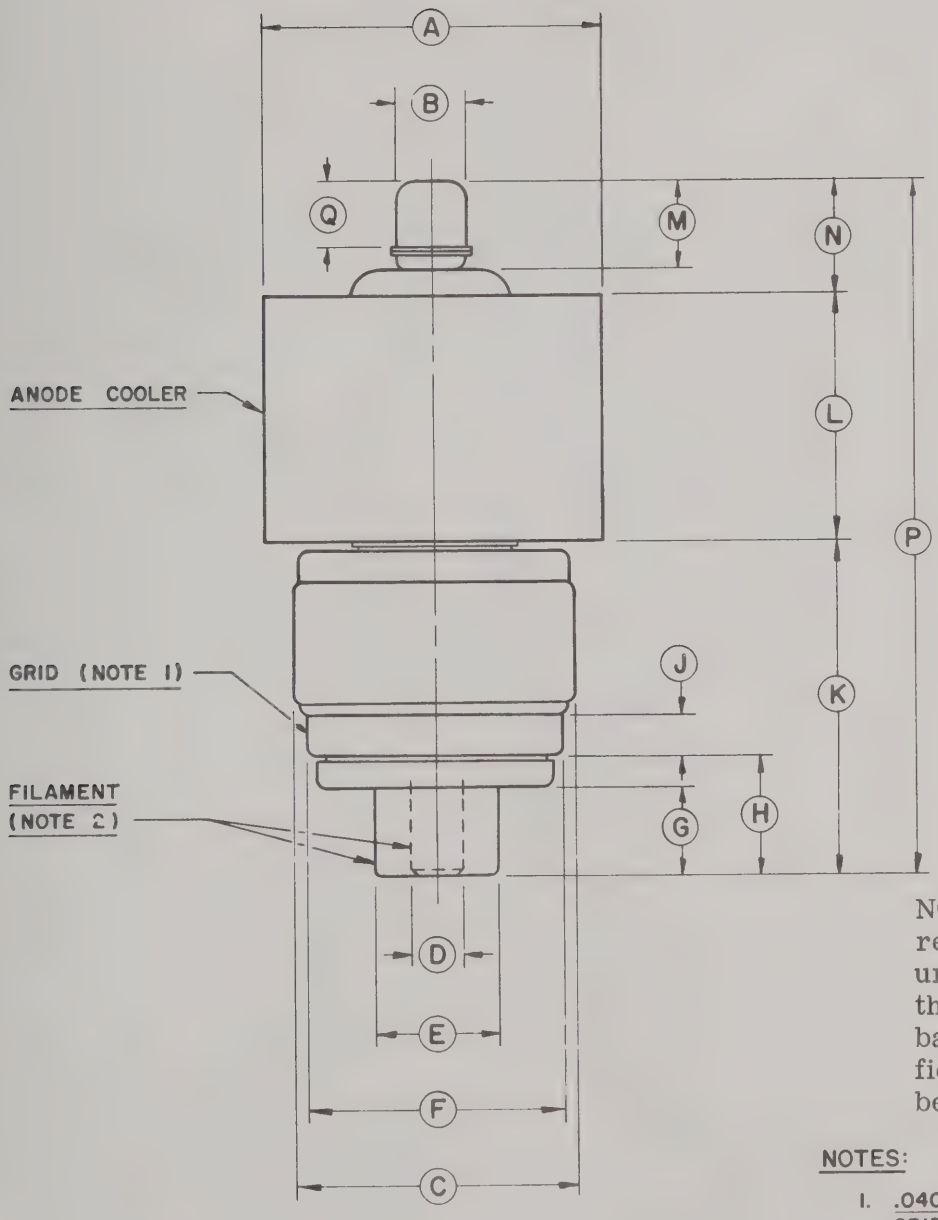
Filament: The rated filament voltage for the 3X3000A1 is 7.5 volts and should not exceed this value by more than five percent if maximum tube life is to be realized. Reduction of filament voltage to about 7.2 volts will actually enhance tube life and provision should be made for this adjustment where the lower emission can be tolerated.

Grid Operation: The grid dissipation rating of the 3X3000A1 is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service, provision should be made for individual adjustment of bias voltage, in order to match the tubes. In practice, individual adjustment of drive voltage will not be necessary.

Special Applications: If it is desired to operate the tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES

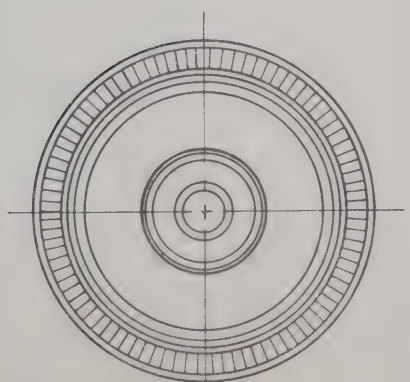
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4.093	4.156	
B	.781	.843	
C		3.625	
D	.615	.635	
E	1.490	1.510	
F	2.990	3.010	
G	.812	.937	
H	1.437	1.562	
J	.375	.437	
K	4.	4.125	
L	2.968	3.031	
M	1.	1.125	
N	1.187	1.437	
P	8.156	8.593	
Q	.687	.812	

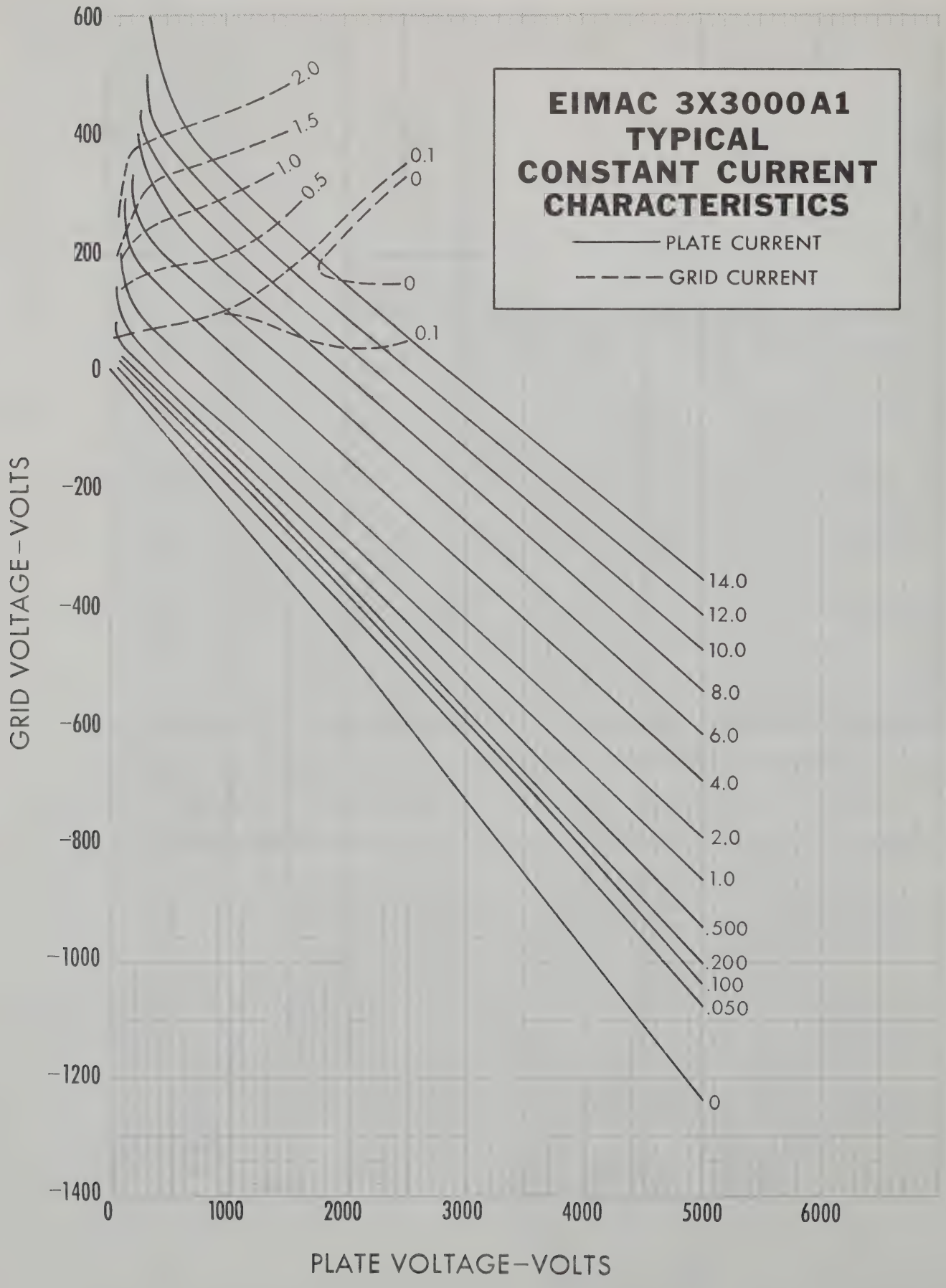


NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.

NOTES:

1. .040 MAX. RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAX. RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.




EIMAC 3X3000A1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
600
400
200
0
−200
−400
−600
−800
−1000
−1200
−1400
GRID VOLTAGE–VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE–VOLTS
2.0
1.5
1.0
0.5
0.1
0
0
0.1
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1.0
.500
.200
.100
.050
0

EIMAC
Division of Varian

TENTATIVE DATA

3X3000A7

HIGH-MU POWER TRIODE

The Eimac 3X3000A7 is an external-anode power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain of over twenty times can be obtained with the 3X3000A7.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten	
Voltage	7.5 volts
Current	51 amperes
Amplification Factor	200
Interelectrode Capacitances:	
Grid-Filament	38 uuf
Grid-Plate	24 uuf
Plate-Filament	0.6 uuf
Frequency for Maximum Ratings	75 Mc

MECHANICAL

Base	See outline drawing
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core and Seals	175°C
Maximum Dimensions:	
Height	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds

AF AMPLIFIER OR MODULATOR
CLASS-B, GRID-DRIVEN

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	5000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

*Approximate Values

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	4000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	0.640 amps
Max-Sig DC Plate Current	4.00 amps
Max-Sig DC Grid Current	0.860 amps
Driving Power	120 watts
Peak AF Driving Voltage (per tube)	185 volts
Load Resistance, Plate-to-Plate	2200 ohms
Max-Sig Plate Output Power	11,000 watts

(Effective 5-20-63) © Copyright 1963 by Eitel-McCullough, Inc.

RF LINEAR AMPLIFIER
CLASS-B, GROUNDED-GRID

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

*Approximate Value

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	4000	5000 volts
Zero-Sig DC Plate Current*	0.32	0.44 amps
Max-Sig DC Plate Current	2.00	1.56 amps
Max-Sig DC Grid Current	0.42	0.33 amps
Driving Impedance	50	50 ohms
Resonant Load Impedance	1120	1850 ohms
Max-Sig Driving Power	360	215 watts
Peak Envelope Plate Output Power	5500	5500 watts
Power Gain	15.3	25.6 times

RF LINEAR AMPLIFIER
CARRIER CONDITIONS, GRID-DRIVEN

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

*Approximate Value
†Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	4000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	0.32 amps
DC Plate Current	0.815 amps
DC Grid Current	0.205 amps
Driving Impedance†	220 ohms
Peak Driving Voltage†	160 volts
Driving Power	15 watts
Plate Output Power	1100 watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

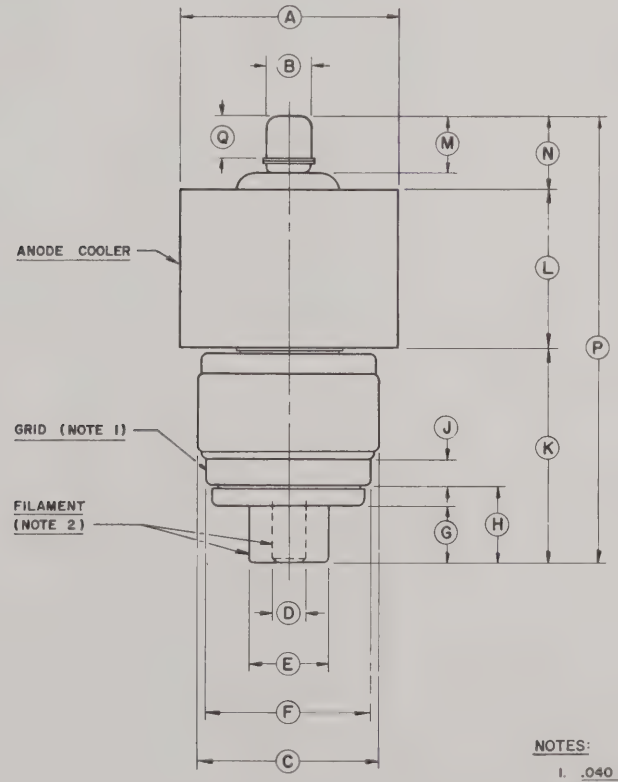
Input Circuit—When the 3X3000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

Cooling—The maximum temperature rating for the anode core and seals of the 3X3000A7 is 175°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperatures of the glass-to-metal seals below 175°C. Tube life is usually prolonged if these areas are maintained at temperatures below the maximum rating. Minimum air flow requirements to maintain anode-core and seal temperatures below 175°C at sea level with an inlet-air temperature of 50°C are tabulated for air-flow in the anode-to-base and base-to-anode directions. At higher ambient temperatures, frequencies above 30 Mc or at higher altitude, a greater quantity of air will be required. It is suggested that temperatures be monitored in any new installation to insure proper cooling.

In addition, a minimum air flow of 7 cfm must be directed into the filament stem structure, between the inner and outer filament conductors. This rate of air flow provides sufficient stem cooling at ambient temperatures up to 55°C.

Minimum Cooling Air-Flow Requirements				
	Anode-To-Base Air-Flow		Base-To-Anode Air Flow	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	42	0.4	25	0.15
2000	109	2.25	63	0.75
3000	215	7.8	130	2.6

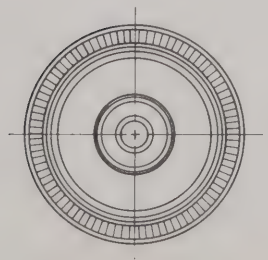
**Since the power dissipated by the filament is about 375 watts and since grid dissipation can, under some circumstances, represent another 225 watts, allowance has been made in preparing this tabulation for an additional 600 watts dissipation.



DIMENSIONS IN INCHES

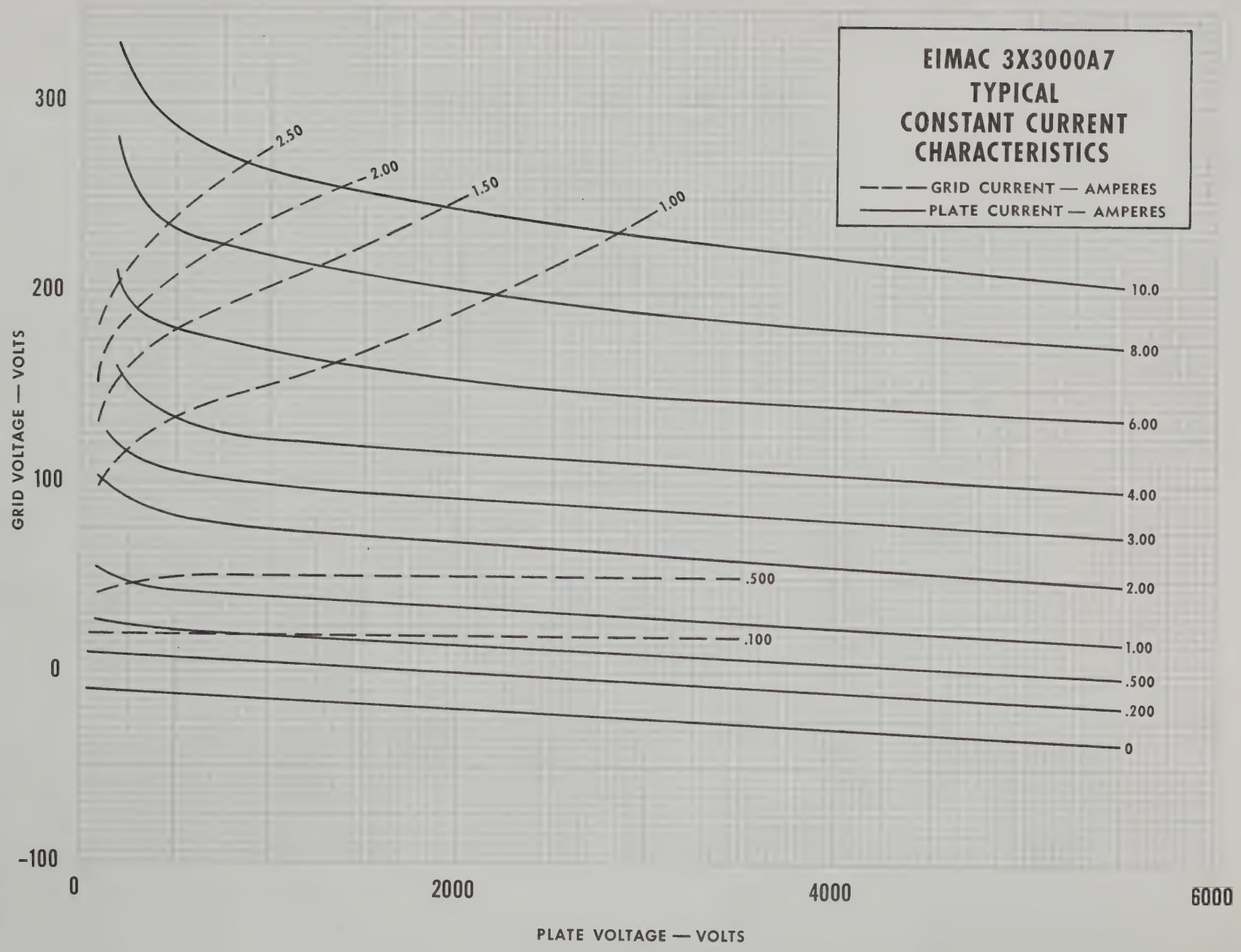
DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	4.093	4.156	
B	.781	.843	
C		3.625	
D	.615	.635	
E	1.490	1.510	
F	2.990	3.010	
G	.812	.937	
H	1.437	1.562	
J	.375	.437	
K	4.	4.125	
L	2.968	3.031	
M	1.	1.125	
N	1.187	1.437	
P	8.156	8.593	
Q	.687	.812	



NOTES:

1. .040 MAX. RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAX. RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.


EIMAC 3X3000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
GRID VOLTAGE — VOLTS
300
200
100
0
-100
0
2000
4000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.500
.100
10.0
8.00
6.00
4.00
3.00
2.00
1.00
.500
.200
0

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

8239
3X3000F1

LOW-MU TRIODE



The Eimac 8239/3X3000F1 is a low-mu forced-air cooled power triode intended for use as an audio amplifier or modulator. The maximum rated plate dissipation is 3000 watts.

Two 3X3000F1's in class-AB_1 audio service will deliver up to 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

The 3X3000F1 is provided with "flying leads" for filament and grid connections.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor	4.4		5.6	
Direct Interelectrode Capacitances (Average)				
Grid-Plate		17		uufd
Grid-Filament		29		uufd
Plate-Filament		2.5		uufd
Transconductance (I_b = 1.0 amp., E_b = 3000 V)		11,000		umhos
Maximum Frequency			30	Mc

MECHANICAL

Base	See outline drawing
Mounting Position	Vertical, base down or up
Cooling	Forced air
▶ Maximum Temperatures:	
Grid and Filament Seals	175°C
Anode Cooler Core	250°C
Maximum Diameter	4.16 inches
Net Weight	7.5 pounds
Shipping Weight	17 pounds

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	6000 MAX.	VOLTS
DC PLATE CURRENT	2.5 MAX.	AMPERES
PLATE DISSIPATION	3000 MAX.	WATTS
GRID DISSIPATION	50 MAX.	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ±15%. Effective grid-circuit resistance must not exceed 200,000 ohms.

**At maximum signal without negative feedback.

TYPICAL OPERATION (Sinusoidal wave, two tubes)
Class AB_1

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage (Approx)*	-860	-1080	-1300	volts
Zero-Signal DC Plate Current	500	400	335	mA
Max-Signal DC Plate Current	3.00	2.80	2.65	amps
Effective Load, Plate-to-Plate	2160	3320	4560	ohms
Peak AF Grid Input Voltage (per tube)	760	995	1250	volts
Max-Signal Driving Power	0	0	0	watts
Max-Signal Plate Input Power	12,000	14,000	16,000	watts
Max-Signal Plate Dissipation (per tube)	3000	3000	3000	watts
Max-Signal Plate Output Power	6000	8000	10,000	watts
Total Harmonic Distortion**	1.8	2.6	2.1	percent

(Effective 2-18-63) © Copyright 1959, 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

▶ Change from data sheet dated 10-21-59

APPLICATION

MECHANICAL

Mounting: The 3X3000F1 must be mounted vertically with its base up or down at the convenience of the designer. The base is fitted with heavy filament leads to facilitate connections. These leads should be arranged to prevent mechanical stress on the filament structure. The grid is also fitted with a flying lead.

The tube must be protected from severe shock and vibration during shipment and operation.

Cooling: Sufficient forced air cooling must be provided to maintain seal temperature at 175° C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

The table below lists minimum air-flow requirements to maintain tube temperatures below 175° C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 25° C and sea level. A separate supply of approximately six cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

	MINIMUM COOLING AIR-FLOW REQUIREMENTS			
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)
1000	14	0.1	20	0.1
2000	37	0.3	61	0.8
3000	74	1.0	122	3.0

Note:
An extra 425 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for grid and filament dissipation.

For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

ELECTRICAL

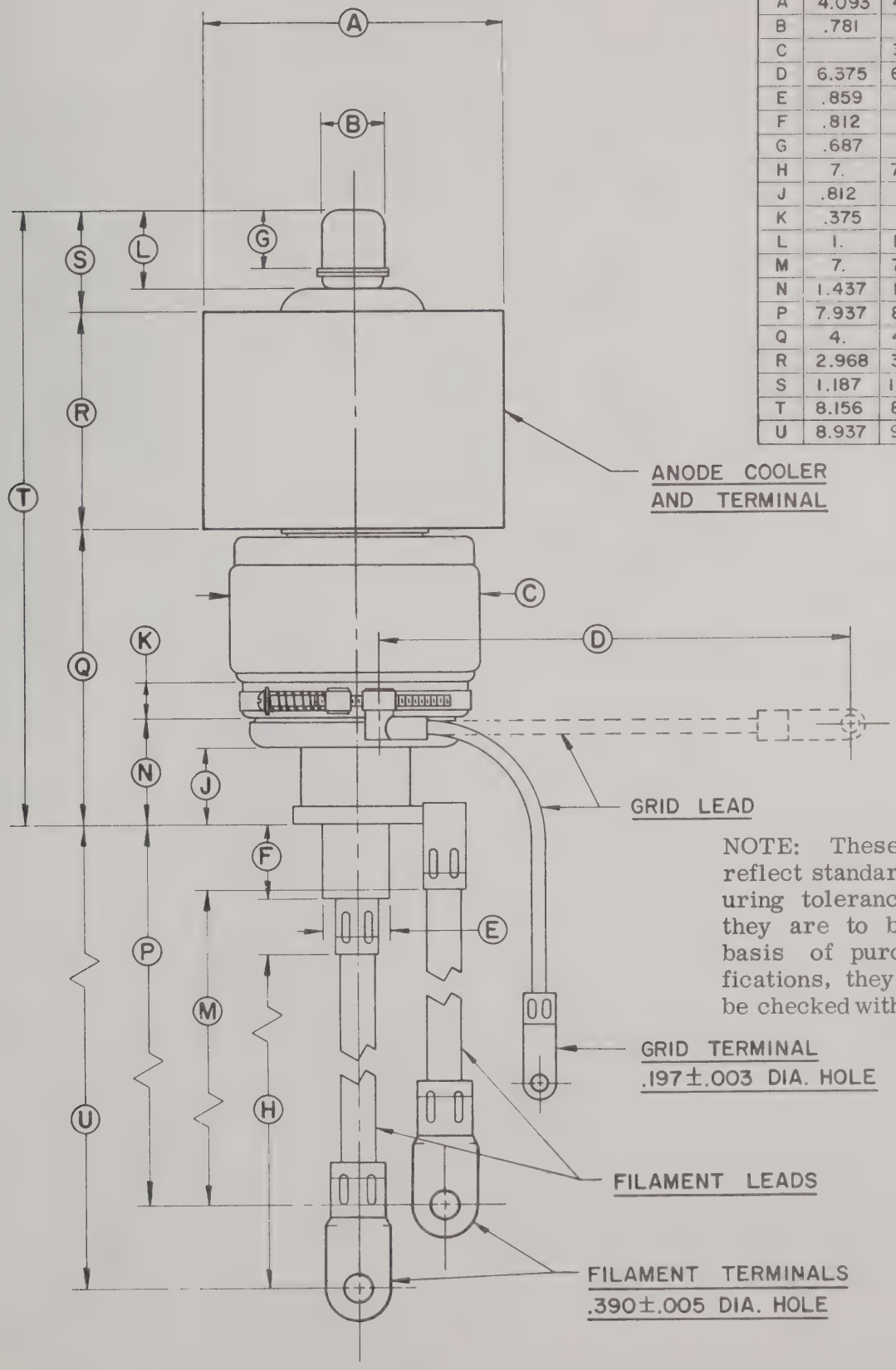
Filament: The rated filament voltage for the 3X3000F1 is 7.5 volts and should not exceed this value by more than five percent if maximum tube life is to be realized. Reduction of filament voltage to about 7.2 volts will actually enhance tube life and provision should be made for this adjustment where the lower emission can be tolerated.

Grid Operation: The grid dissipation rating of the 3X3000F1 is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service, provision should be made for individual adjustment of bias voltage, in order to match the tubes. In practice, individual adjustment of drive voltage will not be necessary.

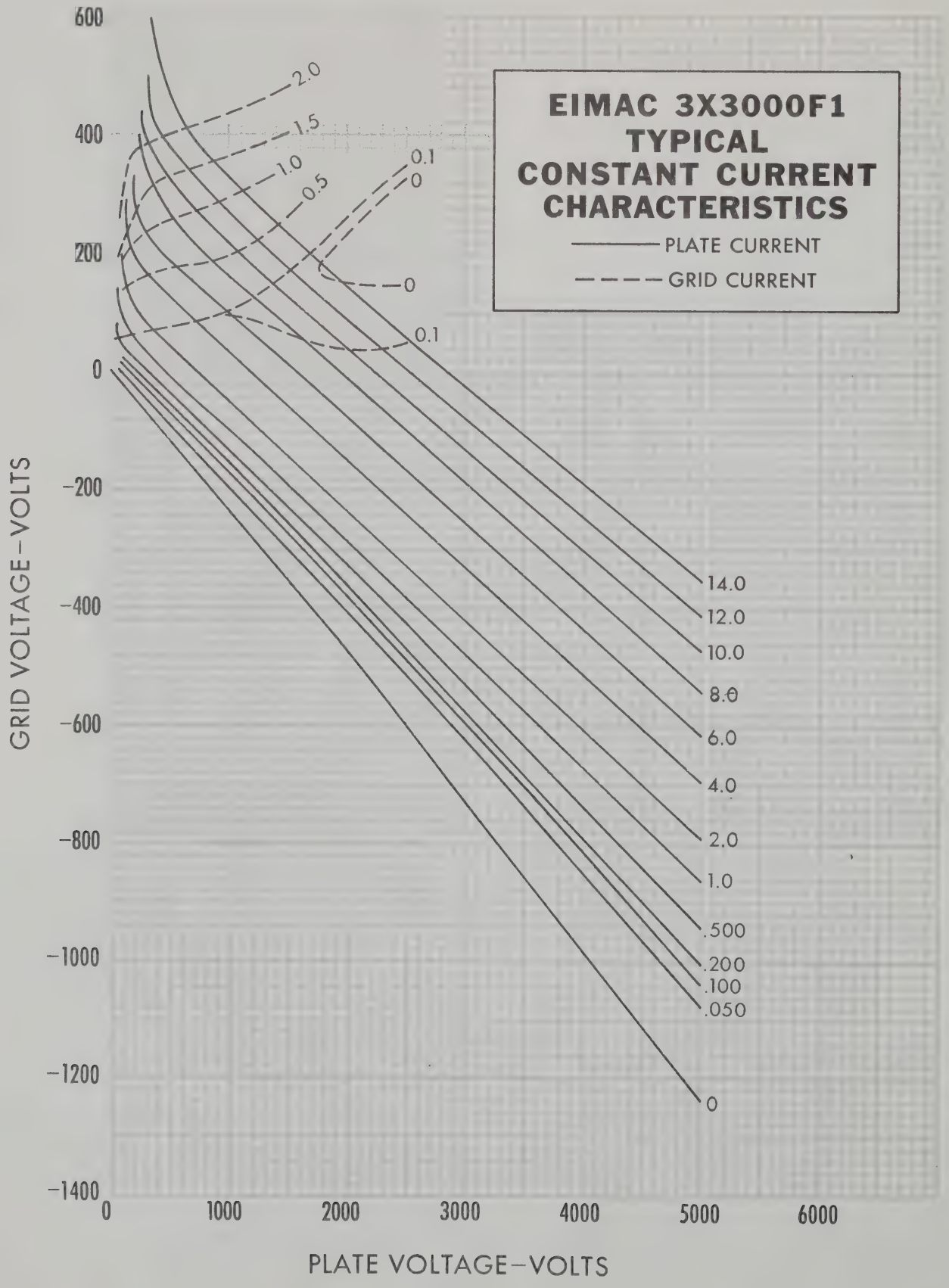
Special Applications: If it is desired to operate the tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4.093	4.156	
B	.781	.843	
C		3.625	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	.687	.812	
H	7.	7.500	
J	.812	.937	
K	.375	.437	
L	1.	1.125	
M	7.	7.500	
N	1.437	1.562	
P	7.937	8.437	
Q	4.	4.125	
R	2.968	3.031	
S	1.187	1.437	
T	8.156	8.593	
U	8.937	9.437	



NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.


EIMAC 3X3000F1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
600
400
200
0
-200
-400
-600
-800
-1000
-1200
-1400
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–VOLTS
2.0
1.5
1.0
0.5
0.1
0
0
0.1
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1.0
.500
.200
.100
.050
0

EIMAC
Division of Varian

TENTATIVE DATA

8162
3X3000F7

HIGH-MU POWER TRIODE



The Eimac 8162/3X3000F7 is an external-anode power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain of over twenty times can be obtained with the 8162/3X3000F7.

GENERAL CHARACTERISTICS

ELECTRICAL		
Filament: Thoriated-Tungsten		
Voltage	7.5	volts
Current	51	amperes
Amplification Factor	200	
Interelectrode Capacitances:		
Grid-Filament	38	uuf
Grid-Plate	24	uuf
Plate-Filament	0.6	uuf
Frequency for Maximum Ratings	30	Mc
MECHANICAL		
Base	See outline drawing	
Operating Position	Vertical, base up or down	
Cooling	Forced air	
Maximum Operating Temperatures:		
Anode Core and Seals	150°C	
Maximum Dimensions:		
Height (Does not include filament connectors)	8.6	inches
Diameter	4.16	inches
Net Weight	7.5	pounds

A-F AMPLIFIER OR MODULATOR
CLASS-B, GRID-DRIVEN

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	5000 VOLTS
D-C PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

TYPICAL OPERATION, Two Tubes,
Sinusoidal Wave

D-C Plate Voltage	4000	volts
D-C Grid Voltage	0	volts
Zero-Sig D-C Plate Current*	0.640	amps
Max-Sig D-C Plate Current	4.00	amps
Max-Sig D-C Grid Current	0.860	amps
Driving Power	120	watts
Peak A-F Driving Voltage (per tube)	185	volts
Load Resistance, Plate-to-Plate	2200	ohms
Max-Sig Plate Output Power	11,000	watts

(Effective 5-5-61) Copyright 1961 by Eitel-McCullough, Inc.

R-F LINEAR AMPLIFIER
CLASS-B, GROUNDED-GRID

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	5000 VOLTS
D-C PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

TYPICAL OPERATION, Single-Tone Conditions

D-C Plate Voltage	4000	5000	volts
Zero-Sig D-C Plate Current*	0.32	0.44	amps
Max-Sig D-C Plate Current	2.00	1.56	amps
Max-Sig D-C Grid Current	0.42	0.33	amps
Driving Impedance	50	50	ohms
Resonant Load Impedance	1120	1850	ohms
Max-Sig Driving Power	360	215	watts
Peak Envelope Plate Output Power	5500	5500	watts
Power Gain	15.3	25.6	times

R-F LINEAR AMPLIFIER
CARRIER CONDITIONS, GRID-DRIVEN

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	5000 VOLTS
D-C PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	3 KW
GRID DISSIPATION	225 WATTS

TYPICAL OPERATION

D-C Plate Voltage	4000	volts
D-C Grid Voltage	0	volts
Zero-Sig D-C Plate Current*	0.32	amps
D-C Plate Current	0.815	amps
D-C Grid Current	0.205	amps
Driving Impedance †	220	ohms
Peak Driving Voltage †	160	volts
Driving Power	15	watts
Plate Output Power	1100	watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

INPUT CIRCUIT - When the 3X3000F7 is operated as a grounded-grid r-f amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

COOLING - The maximum temperature rating for the anode core and seals of the 3X3000F7 is 150°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperatures of the glass-to-metal seals below 150°C. Tube life is usually prolonged if these areas are maintained at temperatures below the maximum rating. Minimum air flow requirements to maintain anode-core and seal temperatures below 150°C with inlet-air temperatures of 40°C and 55°C are tabulated. A maximum ambient temperature of 40°C will apply to most commercial installations, while the 55°C data is useful when designing equipment in conformance with MIL-E-5400 Curve A (Class I).

In addition, a minimum air flow of 7 CFM must be directed into the filament stem structure, between the inner and outer filament conductors. This rate of air flow provides sufficient stem cooling at ambient temperatures up to 55°C.

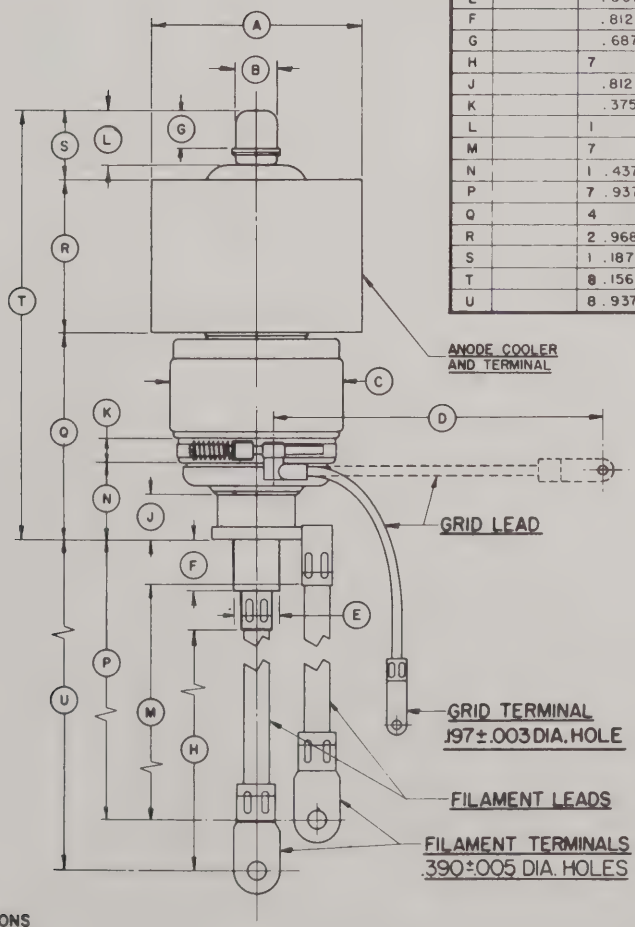
*Approximate Values

†Modulation Crest Conditions

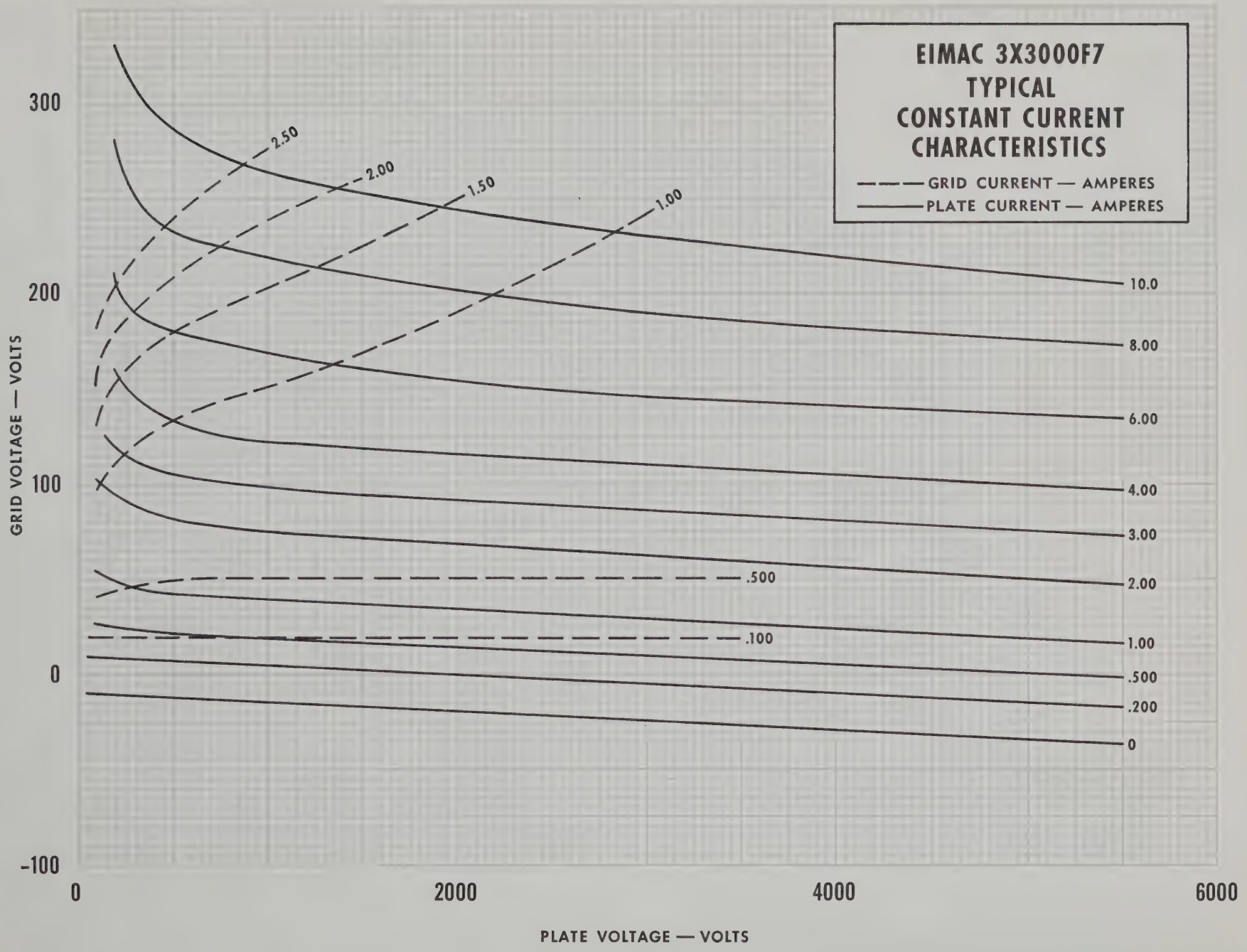
SEA LEVEL PRESSURE, ANODE-TO-BASE AIR FLOW				
	40°C Max Ambient Air Temp.		55°C Max Ambient Air Temp.	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	45	0.43	65	0.65
2000	120	1.6	170	2.5
3000	235	4.0	330	6.0

**Since the power dissipated by the filament is about 375 watts and since grid dissipation can, under some circumstances, represent another 225 watts, allowance has been made in preparing this tabulation for an additional 600 watts dissipation.

DIMENSION DATA			
REF.	NOM	MIN	MAX
A		4.093	4.156
B		.781	.843
C			3.625
D		6.375	6.625
E		.859	.890
F		.812	.937
G		.687	.812
H		7	7.500
J		.812	.937
K		.375	.437
L		1	1.125
M		7	7.500
N		1.437	1.562
P		7.937	8.437
Q		4	4.125
R		2.968	3.031
S		1.187	1.437
T		8.156	8.593
U		8.937	9.437



ALL DIMENSIONS IN INCHES



Printed in U.S.A. 966

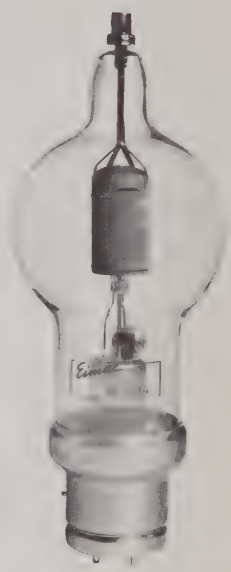
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

250TH
HIGH-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 250TH is a high-mu power triode intended for use as an amplifier, oscillator or modulator. It has a maximum plate-dissipation rating of 250 watts and a maximum plate-voltage rating of 4000 volts at frequencies up to 40 MHz.

The 250TH in class-C rf service will deliver up to 1000 watts plate power output with 39 watts driving power. Two 250TH's in class-AB_2 modulator service will deliver up to 1180 watts maximum-signal plate power output with 42 watts nominal driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	10.5 amperes
Amplification Factor (Average)	37
Direct Interelectrode Capacitances (Average)	
Grid-Plate	2.9 $\mu\mu$f
Grid-Filament	4.6 $\mu\mu$f
Plate-Filament	0.5 $\mu\mu$f
Transconductance (I_b=300 ma., E_b=3000 v.)	5600 μmhos
Highest Frequency for Maximum Ratings	40 MHz

MECHANICAL

Base	Special 4-pin
Basing	See outline drawing
Socket	(National No. XM-50 or E. F. Johnson No. 123-211) or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat-Dissipating Connectors:	
Plate	EIMAC HR-6
Grid	EIMAC HR-3
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.81 inches
Net Weight	10 ounces
Shipping Weight	3 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	350 MA
PLATE DISSIPATION	250 WATTS
GRID DISSIPATION	40 WATTS

TYPICAL OPERATION, per tube (Frequencies up to 40 MHz)

DC Plate Voltage	2000	3000	4000 volts
DC Grid Voltage	—100	—150	—220 volts
DC Plate Current	357	333	313 ma
DC Grid Current*	94	90	93 ma
Peak RF Grid Voltage (approx.)	345	395	470 volts
Driving Power*	29	32	39 watts
Grid Dissipation	20	19	18 watts
Plate Power Input	714	1000	1250 watts
Plate Dissipation	250	250	250 watts
Plate Power Output	464	750	1000 watts

(Revised 6-15-66) © 1953, 1966 Varian

Printed in U.S.A.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS, PER TUBE
(Frequencies up to 40 MHz)

DC PLATE VOLTAGE	3200	VOLTS
DC PLATE CURRENT	280	MA
PLATE DISSIPATION	165	WATTS
GRID DISSIPATION	40	WATTS

TYPICAL OPERATION, per tube[1] (Frequencies up to 40 MHz)

DC Plate Voltage	2000	2500	3000	volts
DC Grid Voltage	—160	—180	—200	volts
DC Plate Current	250	225	200	ma
DC Grid Current*	60	45	38	ma
Peak RF Grid Voltage	365	365	375	volts
Driving Power*	22	17	14	watts
Grid Dissipation*	12	8	6	watts
Plate Power Input	500	565	600	watts
Plate Dissipation	165	165	165	watts
Plate Power Output	335	400	435	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	350	MA
MAX-SIGNAL PLATE DISSIPATION, PER TUBE	250	WATTS
MAX-SIGNAL GRID DISSIPATION	40	WATTS

TYPICAL OPERATION

DC Plate Voltage	1500	2000	3000	volts
DC Grid Voltage[1]	0	—30	—65	volts
Zero-Signal DC Plate Current	220	140	100	ma
Max-Signal DC Plate Current	700	700	560	ma
Effective Load, Plate-to-Plate	4200	6000	12,200	ohms
Peak AF Grid Voltage (per tube)	230	260	260	volts
Max-Signal Peak Driving Power*	92	104	83	watts
Max-Signal Nominal Driving Power*	46	52	42	watts
Max-Signal Plate Power Input	1050	1400	1680	watts
Max-Signal Plate Power Output	630	900	1180	watts

*Approximate values.
[1]Adjust to give stated Zero-Signal DC Plate Current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting — The 250TH must be mounted vertically, base down or up. The plate and grid leads should be flexible, and the tube must be protected from vibration and shock.

Cooling — Heat Dissipation Connectors (EIMAC HR-6 and HR-3 or equivalent) must be used at the plate and grid terminals of the 250TH. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 MHz. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling.

The temperature of the plate and grid seals must not be allowed to exceed 225°C. One method of measuring these temperatures is by the use of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N.Y.

ELECTRICAL

Filament Voltage — The filament voltage, as measured directly at the tube, should be 5.0 volts with maximum allowable variations due to line fluctuations from 5.25 to 4.75 volts.

Bias Voltage — When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

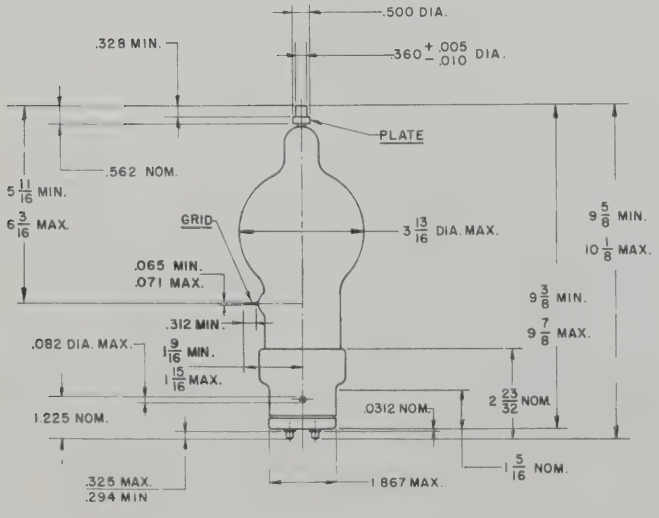
Grid Dissipation — The power dissipated by the grid of the 250TH must not exceed 40 watts. Grid dissipation may be calculated from the following expression:

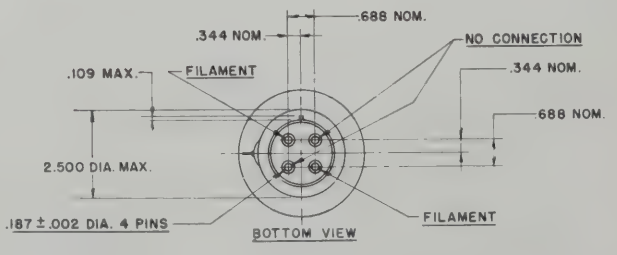
$$P_g = e_{c_{mp}} I_c$$

where P_g = grid dissipation,
e_{mcp} = peak positive grid voltage, and
I_c = dc grid current.

$e_{c_{mp}}$ may be measured by means of a suitable peak-reading voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation — The plates of the 250TH operate at a visibly red color at the maximum rated dissipation of 250 watts. Plate dissipation in excess of the maximum rating is permissible only for short periods of time, such as during tuning procedures.

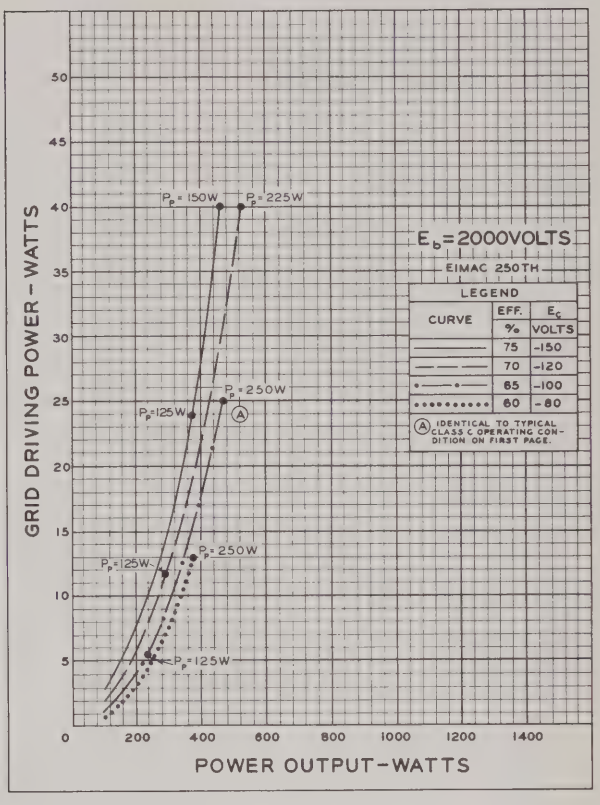


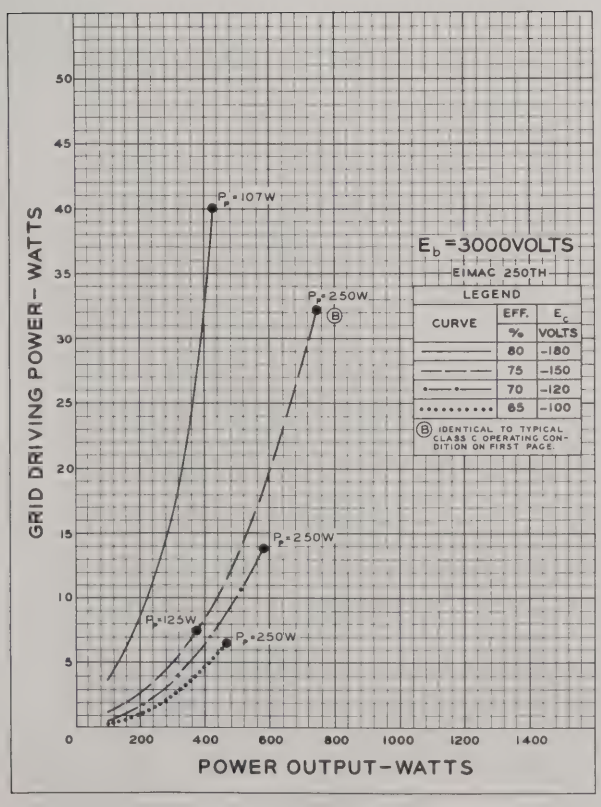


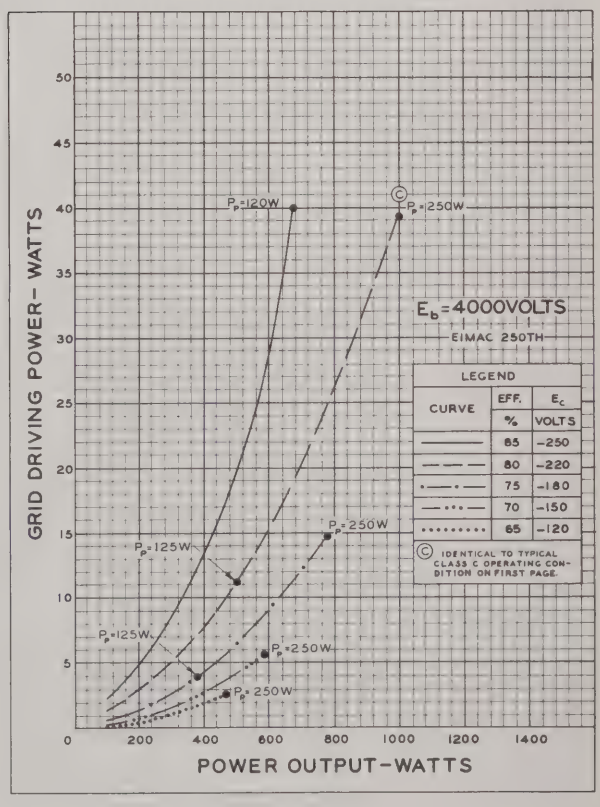
DIMENSIONS IN INCHES

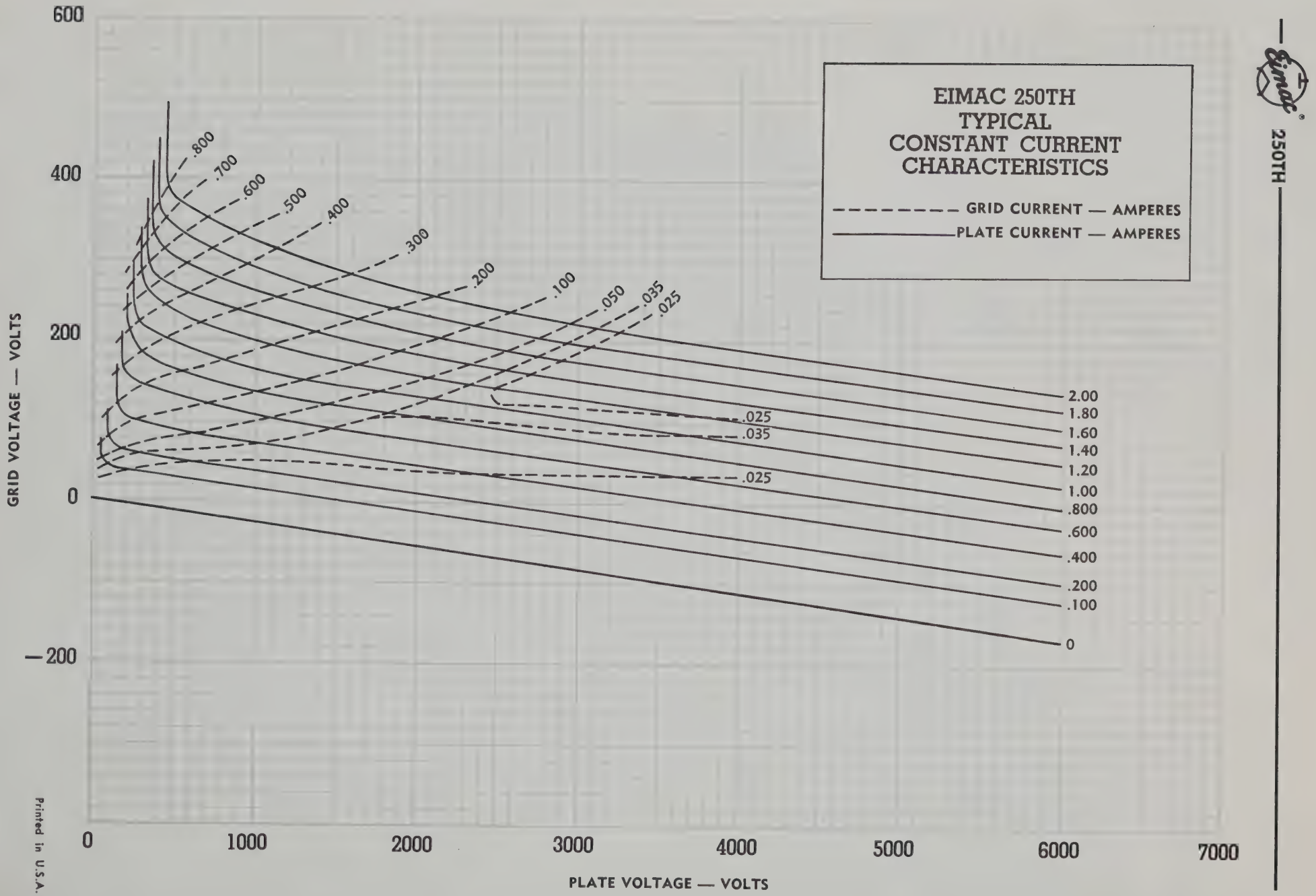
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 2000, 3000, and 4000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 2000, 3000, and 4000 volts respectively.









250TH

Printed in U.S.A. 54406

EIMAC
Division of Varian

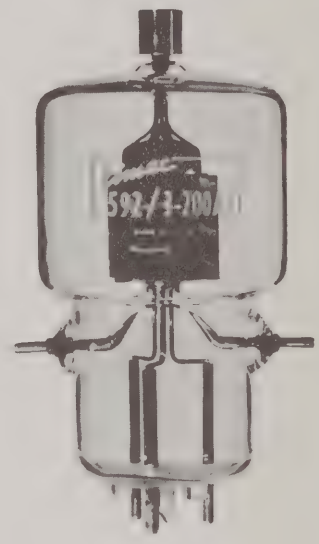
592/3-200A3

MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 592/3-200A3 is a medium-mu power triode having a maximum plate dissipation rating of 200 watts, and it is intended for use as a power amplifier, oscillator, or modulator. It can be used at its maximum ratings at frequencies as high as 150 MHz.

Cooling of the 592/3-200A3 is accomplished by radiation from the plate, which operates at a visible red color at maximum plate dissipation, and by means of forced-air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 volts
Current	5.0 amperes
Amplification Factor (Average)	25
Direct Interelectrode Capacitances (Average)	
Grid-Plate	3.3 $\mu\mu$f
Grid-Filament	3.6 $\mu\mu$f
Plate-Filament	0.29 $\mu\mu$f
Transconductance (I_b=200 ma., E_b=3000 v.)	3600 μmhos
Frequency for Maximum Ratings	150 MHz

MECHANICAL

Mounting	Vertical
Maximum Over-all Dimensions:	
Length	6.0 inches
Diameter	$3\frac{13}{32}$ inches
Net Weight (approx.)	6 ounces
Shipping Weight (approx.)	1½ pounds
Cooling	Radiation and Forced-Air
Recommended Heat Dissipating Connectors:	
Plate	EIMAC HR-10
Grid	EIMAC HR-5
Maximum Bulb Temperature	225°C
Maximum Seal Temperature	175°C

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

MAXIMUM RATINGS

DC PLATE VOLTAGE	3500 VOLTS
MAX-SIGNAL DC PLATE CURRENT	250 MA.
DC PLATE CURRENT	200 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION
Sinusoidal wave, two tubes unless otherwise specified.

DC Plate Voltage	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—50	—70	—90 Volts
Zero-Signal DC Plate Current	120	100	80 Ma.
Max-Signal DC Plate Current	500	450	400 Ma.
Effective Load, Plate-to-Plate	8500	12,600	18,000 Ohms
Peak AF Grid Input Voltage (per tube)	260	270	270 Volts
Max-Signal Peak Driving Power	50	52	40 Watts
Max-Signal Nominal Driving Power (approx.)	25	26	20 Watts
Max-Signal Plate Power Output	600	725	820 Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2600 VOLTS
PLATE DISSIPATION	200 MA.
PLATE DISSIPATION	130 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION

DC Plate Voltage	2000	2500 Volts
DC Plate Current	200	200 Ma.
DC Grid Voltage	—250	—300 Volts
DC Grid Current	35	35 Ma.
Peak RF Grid Input Voltage	480	535 Volts
Driving Power	17	19 Watts
Grid Dissipation	8	9 Watts
Plate Power Input	400	500 Watts
Plate Dissipation	115	125 Watts
Plate Power Output	285	375 Watts

The output figures do not allow for circuit losses.

(Revised 6-15-66) © 1954, 1966 Varian
Printed in U.S.A.

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3500 VOLTS
DC PLATE CURRENT	250 MA.
PLATE DISSIPATION	200 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION

DC Plate Voltage	2000	2500	3000	3500 Volts
DC Plate Current	250	228	222	228 Ma.
DC Grid Voltage	—150	—180	—220	—270 Volts
DC Grid Current	32	28	25	30 Ma.
Peak RF Grid Input Voltage	380	400	440	505 Volts
Driving Power	12	11	11	15 Watts
Grid Dissipation	7	6	5.5	7 Watts
Plate Power Input	500	570	666	800 Watts
Plate Dissipation	200	200	200	200 Watts
Plate Power Output	300	370	466	600 Watts

The output figures do not allow for circuit losses.

APPLICATION

MECHANICAL

Mounting — The 592/3-200A3 must be mounted vertically, base down or base up. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling — An air-flow of approximately 15 cubic feet per minute should be directed at the bulb from a 2 inch diameter nozzle located about three inches from the center line of the tube. The center line of the nozzle should be located about two inches down from the top of the plate terminal. The incoming air temperature should not exceed 50°C. Other methods of cooling may be used provided the maximum bulb and seal temperatures are not exceeded. An 8 inch, household-type fan located about 10 inches from the tube is one alternate method. Special heat-dissipating connectors EIMAC HR-5 and HR-10, or equivalent, for grid and plate terminals respectively) should be used with this tube. These connectors help to prolong tube life by reducing the temperature of the metal-glass seals.

ELECTRICAL

Filament Voltage — For maximum tube life, the filament voltage, as measured directly at the filament pins, should be the rated value of 10.0 volts. Unavoidable variations in filament voltage must be kept within the range of 9.5 to 10.5 volts.

Bias Voltage — There is little advantage in using bias voltages in excess of those given under "Typical Operation" except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation — The power dissipated by the grid of the 592/3-200A3 must not exceed 25 watts. Grid dissipation may be calculated from the following expression:

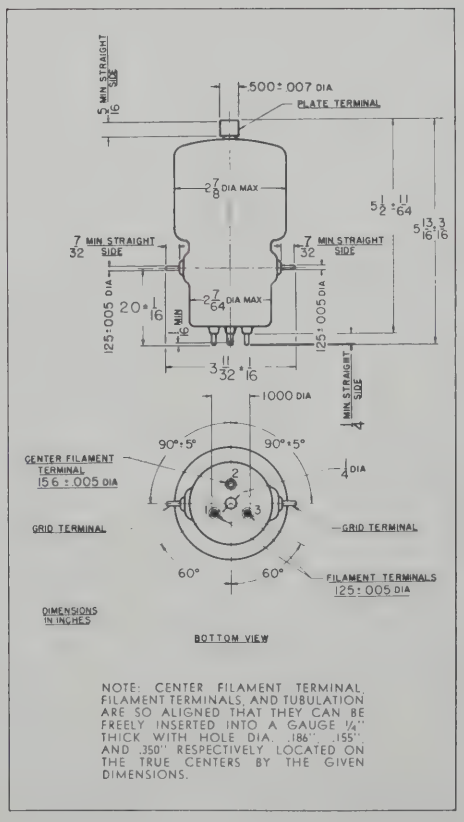
$$P_g = e_{cmp} I_c$$

where P_g = grid dissipation,
e_{cmp} = peak positive grid voltage, and
I_c = dc grid current.

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid.

Plate Voltage—Except for special applications, the plate supply voltage for the 592/3-200A3 should not exceed 3500 volts. In most cases there is little advantage in using plate-supply voltages in excess of those given under "Typical Operation" for the power output desired.

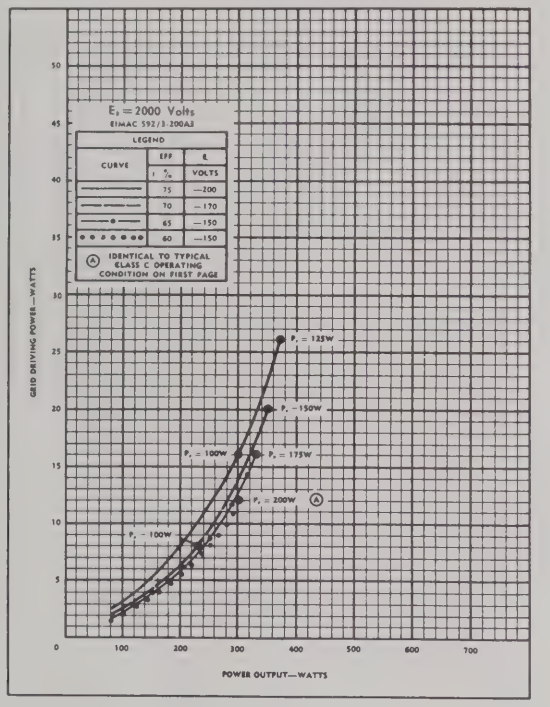
Plate Dissipation — Under normal operating conditions, the power dissipated by the plate of the 592/3-200A3 should not exceed 200 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament, as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

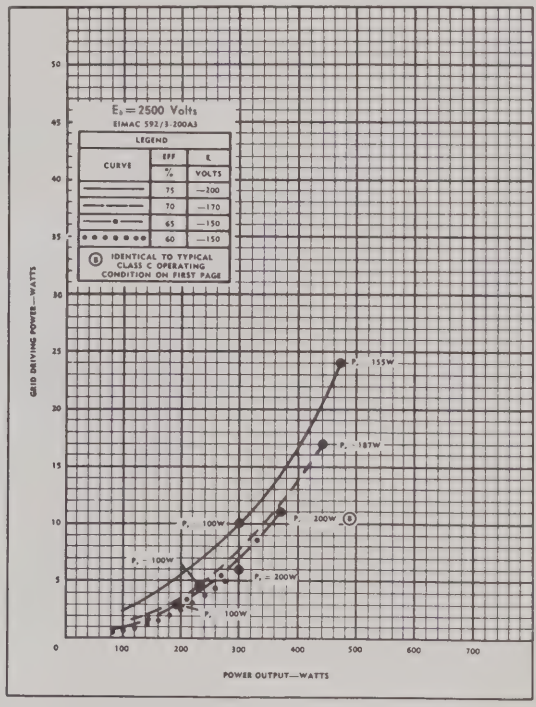


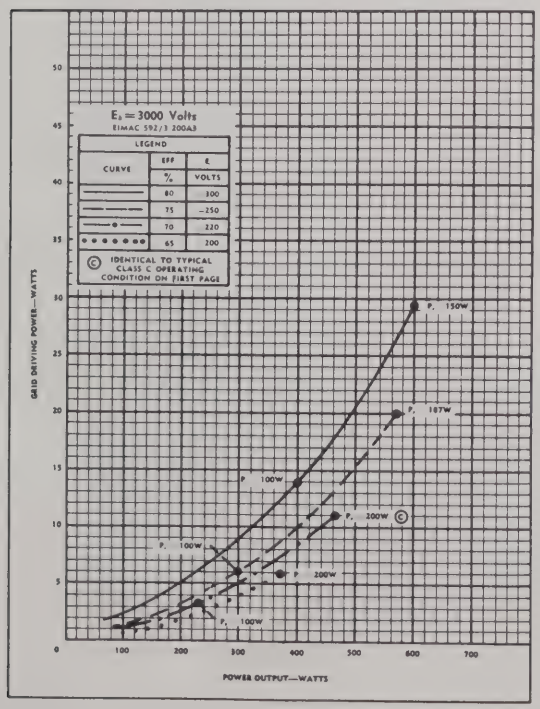
DRIVING POWER vs. POWER OUTPUT

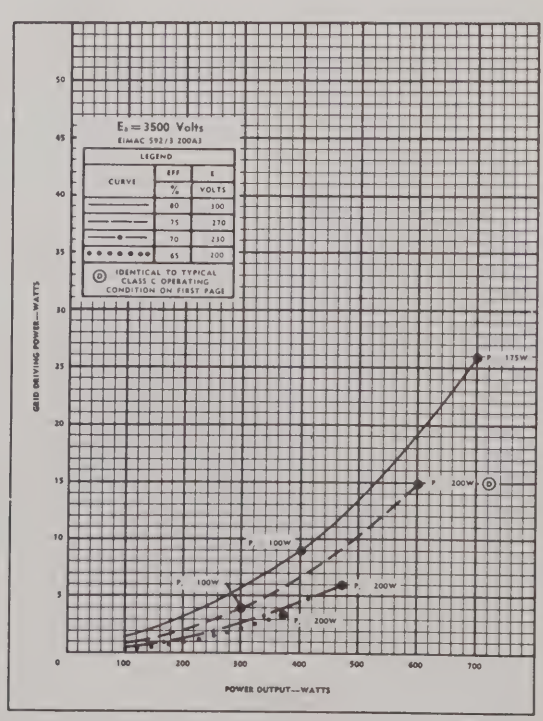
The four charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 2000, 2500, 3000 and 3500 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

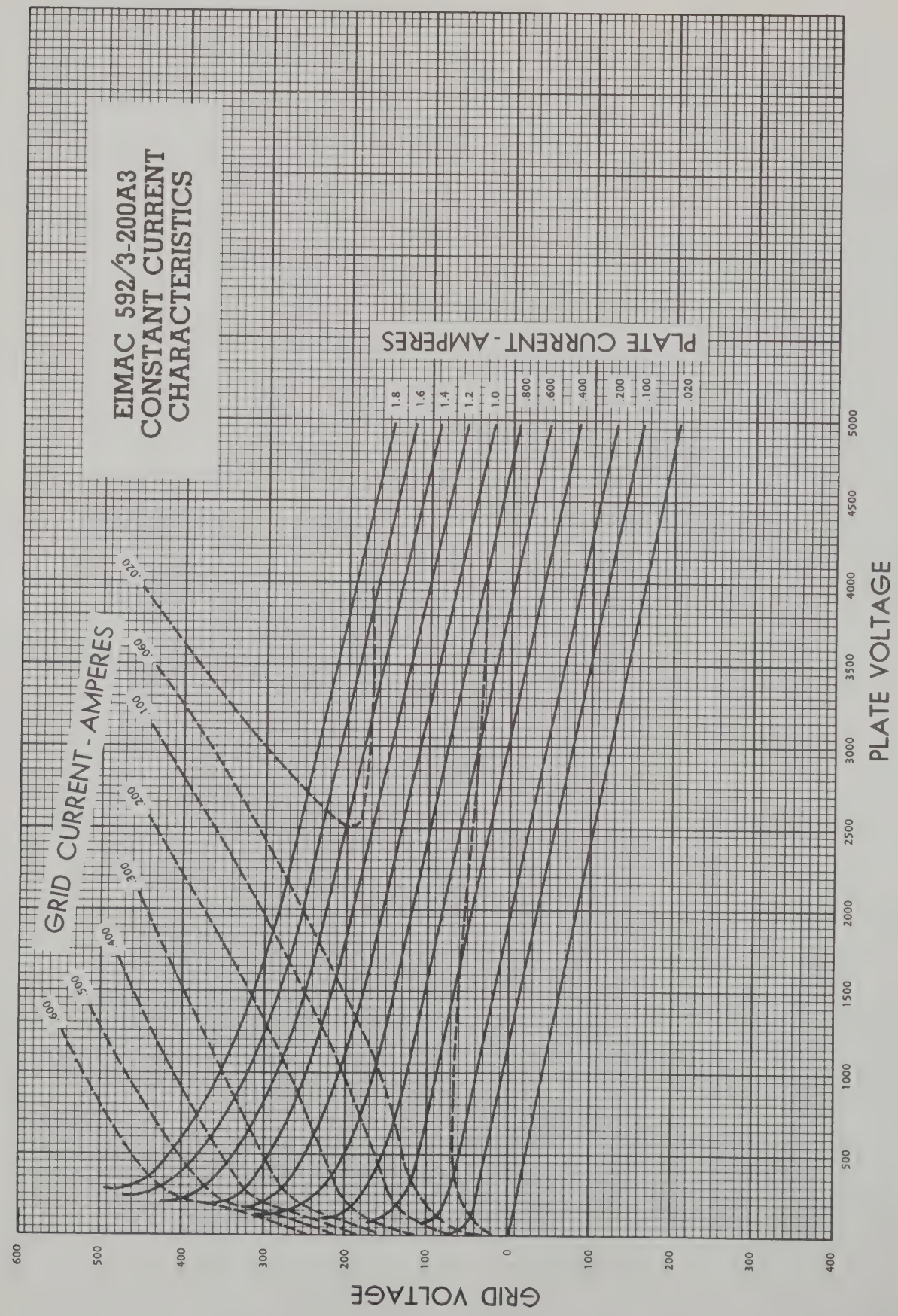
Points A, B, C, and D are identical to the typical Class C operating conditions shown on the first page under 2000, 2500, 3000, and 3500 volts respectively.











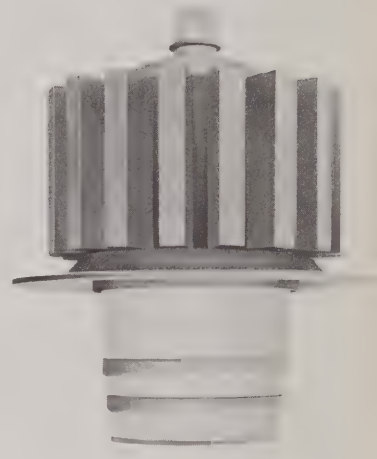
Printed in U.S.A.

EIMAC
A Division of Varian Associates

4CV35,000A

VAPOR-COOLED RADIAL-BEAM POWER-TETRODE

The EIMAC 4CV35,000A is a ceramic-metal power tetrode intended for use as a Class-C amplifier in radio-frequency applications. It features a new type of internal mechanical structure which results in higher RF operating efficiency. Low RF losses in this mechanical structure permit operation of the 4CV35,000A at full ratings up to 110 megahertz. The 4CV35,000A is also recommended for Class-AB audio-frequency and radio-frequency linear power amplifier service. The vapor-cooled anode is rated at 35 kilowatts of plate dissipation, making the tube attractive for low efficiency applications.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		6.3		volts
Current	152		168	amps
Amplification Factor (Grid-Screen) (average)		4.5		

Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	152	172	μμf
Output	22.0	27.0	μμf
Feedback		2.0	μμf
Direct Interelectrode Capacitances, Grounded Grid and Screen:			
Input	63.0	78.0	μμf
Output	23.0	28.0	μμf
Feedback		0.3	μμf

MECHANICAL

Base	Special, concentric
Maximum Seal Temperature	250°C
Maximum Anode Flange Temperature (See Outline Drawing)	110°C
Recommended Socket	EIMAC, SK-310
Boiler	EIMAC, BR-200
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.44 inches
Diameter	7.75 inches
Base Cooling	Forced Air
Net Weight	20 pounds
Shipping Weight (Approximate)	35 pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Revised 5-15-66) © 1962, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION	35,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

TYPICAL OPERATION

DC Plate Voltage	7500	10,000	volts
DC Screen Voltage	750	750	volts
DC Grid Voltage	—515	—540	volts
DC Plate Current	4.95	4.8	amps
DC Screen Current	.580	.585	amp
DC Grid Current	.360	.320	amp
Peak RF Grid Voltage	675	700	volts
Driving Power	240	225	watts
Plate Dissipation	9000	10,000	watts
Plate Output Power	27,000	38,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION*	23,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Corresponds to 35,000 watts at 100 percent sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	6000	8000	volts
DC Screen Voltage	750	750	volts
Peak AF Screen Voltage (For 100% modulation)	—740	710	volts
DC Grid Voltage	—600	—640	volts
DC Plate Current	3.75	3.65	amps
DC Screen Current	.450	.430	mA
DC Grid Current	.185	.180	mA
Peak RF Grid Voltage	800	840	volts
Grid Driving Power	150	150	watts
Plate Dissipation	5100	5800	watts
Plate Output Power	17,400	23,500	watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
PLATE DISSIPATION	35,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Per Tube
**Approximate Values

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	8000	10,000	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	—290	—300	volts
Max-Signal Plate Current	10.7	10.7	amps
Zero-Signal Plate Current*	5.0	5.0	amps
Max-Signal Screen Current**	.390	.340	mA
Zero-Signal Screen Current	0	0	amps
Peak AF Driving Voltage*	280	290	volts
Driving Power	0	0	watts
Load Resistance, Plate-to-Plate	1680	2200	ohms
Max-Signal Plate Dissipation*	16,800	20,500	watts
Max-Signal Plate Output Power	50,000	66,000	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
PLATE DISSIPATION	35,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Approximate Values

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions

DC Plate Voltage	8000	10,000	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	—290	—300	volts
Max-Signal Plate Current	5.35	5.35	amps
Zero-Signal Plate Current	2.5	2.5	amps
Max-Signal Screen Current*	.195	.170	mA
Peak RF Grid Voltage	280	290	volts
Driving Power	0	0	watts
Plate Dissipation	16,800	20,500	watts
Plate Output Power	25,000	33,000	watts
Resonant Load Impedance	840	1100	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting — The 4CV35,000A must be operated with its axis vertical, base up in an EIMAC BR-200 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the the rubber O-ring and boiler. A typical vapor cooling system is shown on the opposite page.

Socket — The EIMAC SK-310 socket is available for use with the 4CV35,000A. Filament, control grid and screen grid connections are made to this socket.

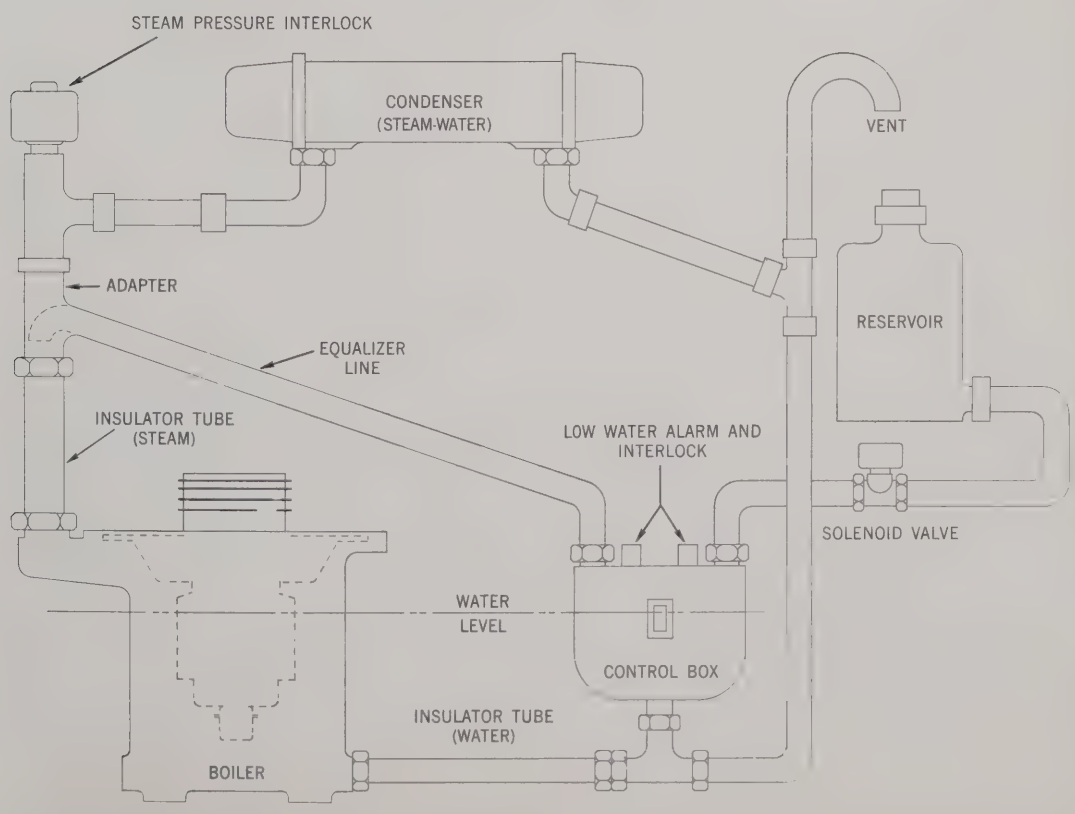
Cooling — Cooling is accomplished by immersing the anode in the distilled water filled BR-200 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system (such as the 4CV35,000A and BR-200), it is extremely unlikely that the anode surfaces will ever exceed 110°C — well below the 250°C maximum rating — at full dissipation ratings.

The water in the boiler must be maintained at a constant level. Just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any losses or drops in liquid level are sensed by the control box CB-202. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-energizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Air cooling of the tube base is required. 100 CFM minimum should be directed straight down toward the center of the SK-310 socket from a blower or duct, not more than 5½ inches from the socket.

VAPOR COOLING SYSTEM



ELECTRICAL

Filament Operation — The rated filament voltage for the 4CV35,000A is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

Control-Grid Operation — The 4CV35,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

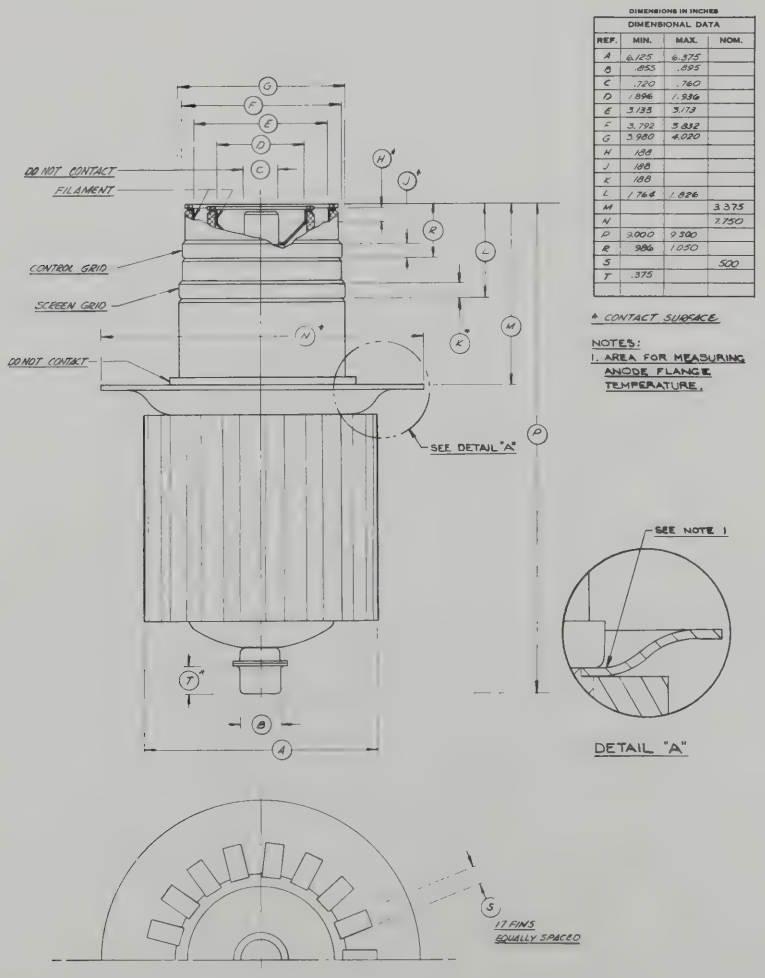
Screen-Grid Operation — The power dissipated by the screen must not exceed 450 watts. Screen dissipation, in cases where no ac is applied to the screen is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

Plate Dissipation — The plate dissipation rating of 35,000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

When the 4CV35,000A is used as a plate-modulated rf amplifier, this rating is reduced to 23,000 watts with a reduced plate input rating of 8000 volts and 4.0 amps.

Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing Department, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.



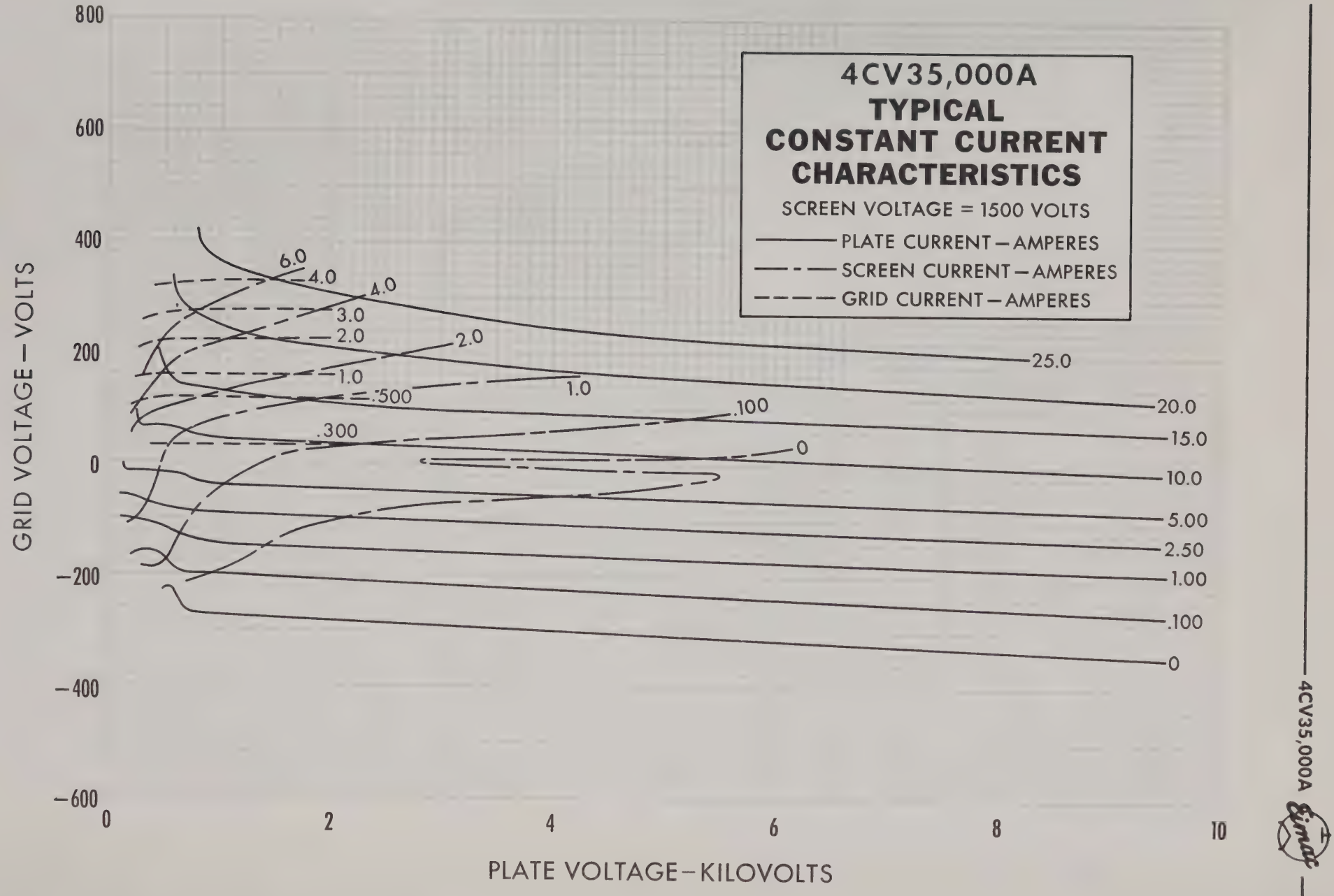
DIMENSIONS IN INCHES

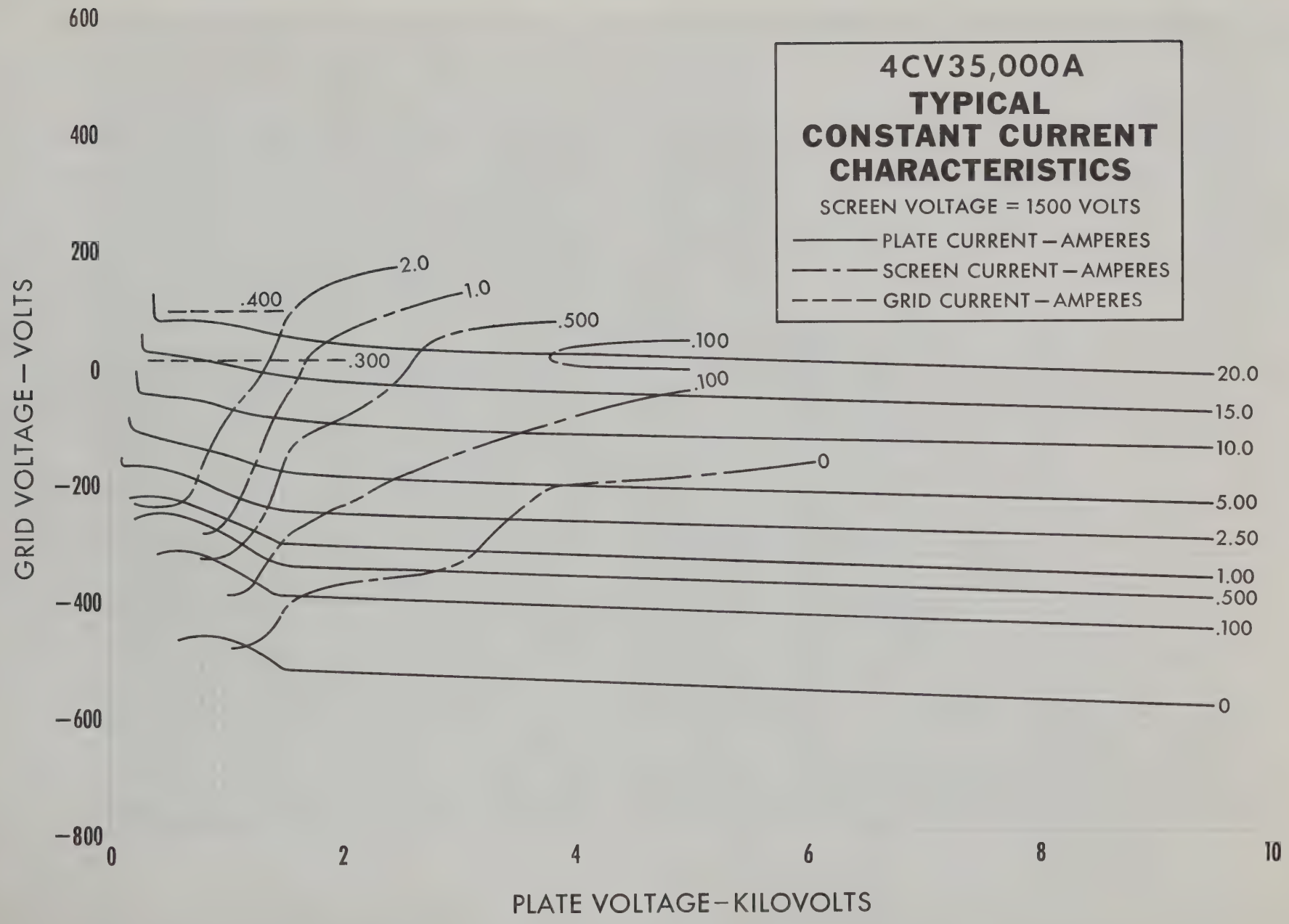
DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	6.125	6.375	
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
G	3.980	4.020	
H	.188		
J	.188		
K	.188		
L	1.764	1.826	
M			3.375
N			7.750
P	2.000	2.390	
R	.986	1.050	
S			.500
T	.375		

* CONTACT SURFACE

NOTES:
1. AREA FOR MEASURING ANODE FLANGE TEMPERATURE.

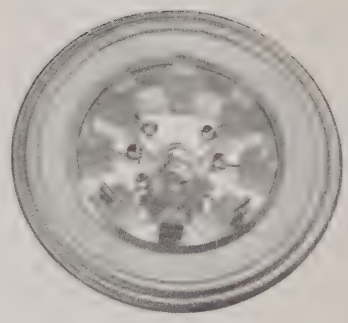

4CV35,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
6.0
4.0
4.0
3.0
2.0
2.0
1.0
.500
1.0
.100
.300
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0


4CV35,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
600
400
200
0
–200
–400
–600
–800
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
2.0
1.0
.500
.100
.400
.300
.100
0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0

TECHNICAL DATA

SK-600A
SK-610A

AIR-SYSTEM SOCKETS



This series of sockets provide terminal connection, cooling air direction, and a low inductance screen bypass capacitor for the power tubes listed below. The SK-600 series sockets may be used with other tube types having similar basing.

These Air-System Sockets are recommended for use with the following tubes:

7034/4X150A	8249/4W300B	8904/4CX350FJ
7203/4CX250B	8321/4CX350A	8930
7580W/4CX250R	8322/4CX350F	8957/4CX250BC
7609	8621/4CX250FG	

Normally the ceramic chimney SK-606 is used with these two sockets to direct the cooling air past the body of the tube as it flows from pressurized chassis through the socket, then through the tube anode fins. Reverse air direction may be used. (Type 8930 uses Chimney SK-646).

The base contact fingers and the screen terminal fingers are heat treated beryllium copper. The base contact fingers are supported and insulated by polytrifluoroethylene, an excellent insulating material even at ultra high frequencies. All contact fingers, and the brass shell are silver plated to insure good contact and to resist corrosion.

These sockets have hermetically sealed screen bypass capacitors to protect against moisture and dirt.

The SK-600A socket has all base terminals brought out separately. The SK-610A has cathode terminals 2, 4, 6 and 8 connected to the shell.

INSTALLATION

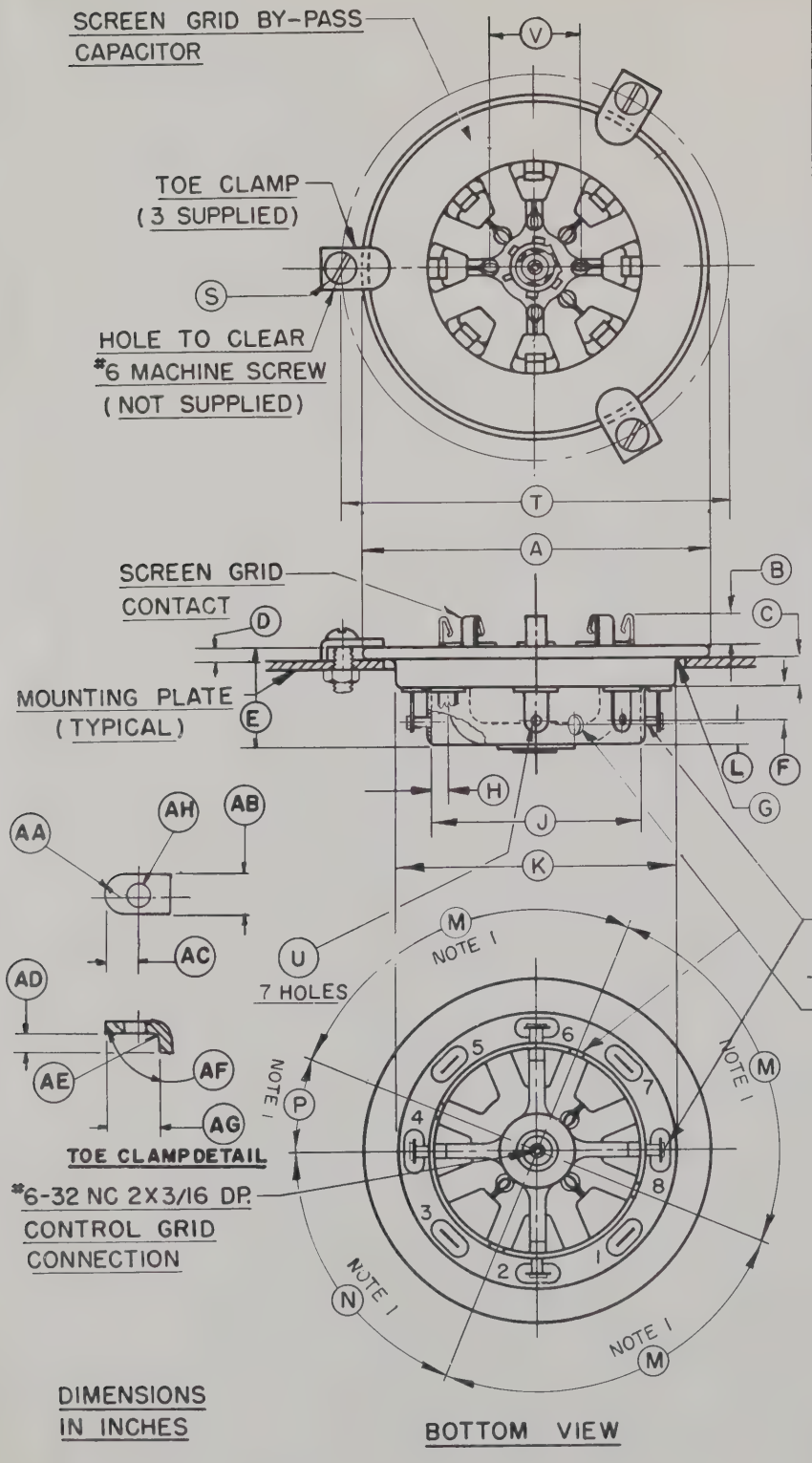
These Air-System Sockets can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2¼" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1⅝" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

CHARACTERISTICS

	SK-600A	SK-610A
SCREEN BYPASS CAPACITOR WORKING VOLTAGE DC	1000	1000
SCREEN BYPASS CAPACITANCE(pF)	2700 ± 500	2700 ± 500
CATHODE TERMINALS CONNECT TO SHELL	No	Yes
SCREEN BYPASS CAPACITOR HERMETICALLY ENCAPSULATED	Yes	Yes
NET WEIGHT	3.5 oz. (99 gms)	3.5 oz. (99 gms)

(Revised 11-1-74)
© 1961, 1965, 1971, 1974 Varian
Printed in U.S.A.



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.688	2.750	- -	68.27	69.85	- -
B	0.234	0.266	- -	5.94	6.76	- -
C	0.203	0.235	- -	5.16	5.97	- -
D	0.125	0.157	- -	3.17	3.99	- -
E	0.844	0.906	- -	21.44	23.01	- -
F	- -	- -	0.250	- -	- -	6.35
G	- -	0.031R	- -	- -	0.79R	- -
H	- -	- -	0.078	- -	- -	1.98
J	1.633	1.643	- -	41.48	41.73	- -
K	2.188	2.208	- -	55.57	56.08	- -
L	0.172	0.204	- -	4.37	5.18	- -
M	89° *	91° *	- -	89° *	91° *	- -
N	66.5° *	68.5° *	- -	66.5° *	68.5° *	- -
P	21.5° *	23.5° *	- -	21.5° *	23.5° *	- -
R	- -	- -	0.144	- -	- -	3.66
S	0.142	- -	- -	3.61	- -	- -
T	- -	- -	3.000	- -	- -	76.20
U	- -	- -	0.090	- -	- -	2.29
V	- -	- -	0.687	- -	- -	17.45
AA	0.125R	0.187R	- -	3.17R	4.75R	- -
AB	0.292	0.332	- -	7.42	8.43	- -
AC	0.292	0.332	- -	7.42	8.43	- -
AD	0.105	0.145	- -	2.69	3.68	- -
AE	- -	0.062R	- -	- -	1.57R	- -
AF	80°	100°	- -	80°	100°	- -
AG	0.417	0.457	- -	10.59	11.61	- -
AH	0.142	0.146	- -	3.61	3.71	- -

*SEE NOTE 1.

CONNECTIONS

NO. 1 SCREEN GRID
" 2 CATHODE
" 3 HEATER
" 4 CATHODE
" 5 NO CONNECTION
" 6 CATHODE
" 7 HEATER
" 8 CATHODE

NOTES:
1 – TOLERANCES ARE NOT CUMULATIVE

3CW30,000H7

TECHNICAL DATA

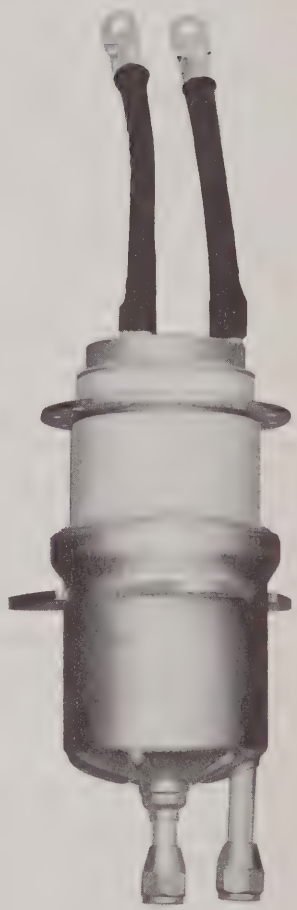
HIGH-MU
WATER-COOLED
POWER TRIODE

The EIMAC 3CW30,000H7 is a ceramic/metal water-cooled high-mu power triode intended for use as a Class C power amplifier or for zero-bias Class B or AB linear amplifier service, and also intended for use as a dc voltage or current regulator, or in high-voltage switch tube or pulsed regulator service.

Internally the tube is identical to the 3CX15,000A7, and except for anode dissipation capability, all ratings are the same.

Class B amplifier operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded grid operation is attractive since a power gain as high as twenty times can be obtained.

The anode power dissipation rating is 30,000 watts with water cooling. No socket is required for the tube because of the mounting flanges attached to the anode and grid and the flexible filament leads on the base.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor (Average):	200
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	61 pF
Cout	0.2 pF
Cgp	36 pF
Direct Interelectrode Capacitance (grounded grid)[2]	
Cin	61 pF
Cout	36 pF
Cpk	0.2 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Effective 2-1-75) © by Varian Printed In U.S.A.

MECHANICAL

Base	Special, with grid contact flange & filament flying leads
Operating Position	Vertical, Anode up or down
Cooling	Water or equivalent liquid & forced air
Maximum Overall Dimensions:	
Length (including filament leads)	20.5 in; 52.1 cm
Diameter (anode mounting flange pitch circle)	6.75 in; 17.1 cm
Maximum Operating Temperature:	
Envelope & Ceramic/Metal Seals	250°C
Net Weight (Approximate)	10.6 lbs; 4.8 kg

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000 VOLTS
DC PLATE CURRENT	6.0 AMPERES
PLATE DISSIPATION	30,000 WATTS
GRID DISSIPATION	500 WATTS

1. Approximate values
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_2

Plate Voltage	7000	7000 Vdc
Grid Voltage	0	0 Vdc
Zero-Signal Plate Current [1]	.6	.6 Adc
Single-Tone Plate Current [2]	5.92	5.0 Adc
Single-Tone Grid Current [1]	1.22	1.0 Adc
Driving Power [1]	1750	1540 W
Plate Dissipation	13.4	10.8 kW
Single-Tone Plate Output Power	29.6	24.2 kW
Resonant Load Impedance	693	745 Ω
Drive Impedance	27	32 Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000 VOLTS
DC GRID VOLTAGE	-500 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	30,000 WATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	7000 Vdc
Grid Voltage	-230 Vdc
Plate Current	4.0 Adc
Grid Current [1]	775 mAdc
Peak rf Grid Voltage [1]	555 v
Calculated Driving Power [1]	430 W
Plate Input Power	28 kW
Plate Dissipation	6.7 kW
Plate Output Power	21.3 kW
Resonant Load Impedance	963 Ω

DC VOLTAGE OR CURRENT REGULATOR SWITCH TUBE OR PULSED REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	28 KILOVOLTS
DC GRID VOLTAGE	-500 VOLTS
DC PLATE CURRENT [1]	6 AMPERES
PULSE PLATE CURRENT	40 AMPERES
DUTY, PULSE SERVICE [2]	0.1
PLATE DISSIPATION [2]	30 KILOWATTS
GRID DISSIPATION [2]	500 WATTS

1. Steady-state value in voltage or current regulator service.
2. With duty in excess of approximately 0.1 excessive element heating may occur during the pulse and consequent element dissipation derating may be required.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid) [1]			
Cin	55.0	67.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode) [1]			
Cin	55.0	67.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitances values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 3CW30,000H7 must be operated vertically, anode down or up, and should be protected from shock and vibration. The anode mounting flange provides a convenient mounting means, and the grid is also provided with a flange for mating with a simple contact assembly. Both filament connections are made with flying leads approximately nine inches long with heavy lugs attached at the ends.

COOLING - The anode of the 3CW30,000H7 is cooled by circulating water through the integral anode water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes an inlet water temperature of 50°C with the anode mounted either up or down. Care should be taken to use the correct cooling water connector for inlet water, which is dependent on the tube orientation (base up or down), and these are shown on the tube outline drawing.

Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure must not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop Approx. psi.
15	12	13.5
20	13	15.0
30	14	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 KΩ/cm , and preferably above 250 KΩ/cm . A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with a minimum of 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the grid and filament contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the terminals with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 3CW30,000H7 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 3CW30,000H7 by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate. For pulsed regulator or switch tube service full nominal filament voltage is recommended.

INPUT CIRCUIT - When the 3CW30,000H7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of 5 or more.

CLASS-C OPERATION - Although designed specifically for Class-B service, the 3CW30,000H7 may be operated as a Class-C amplifier or oscillator or as a plate-modulated radio-frequency amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power should fail, plate dissipation is then kept to a low value because the tube will be operating at normal, static, zero-bias conditions.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these

voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 3CW-30,000H7, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

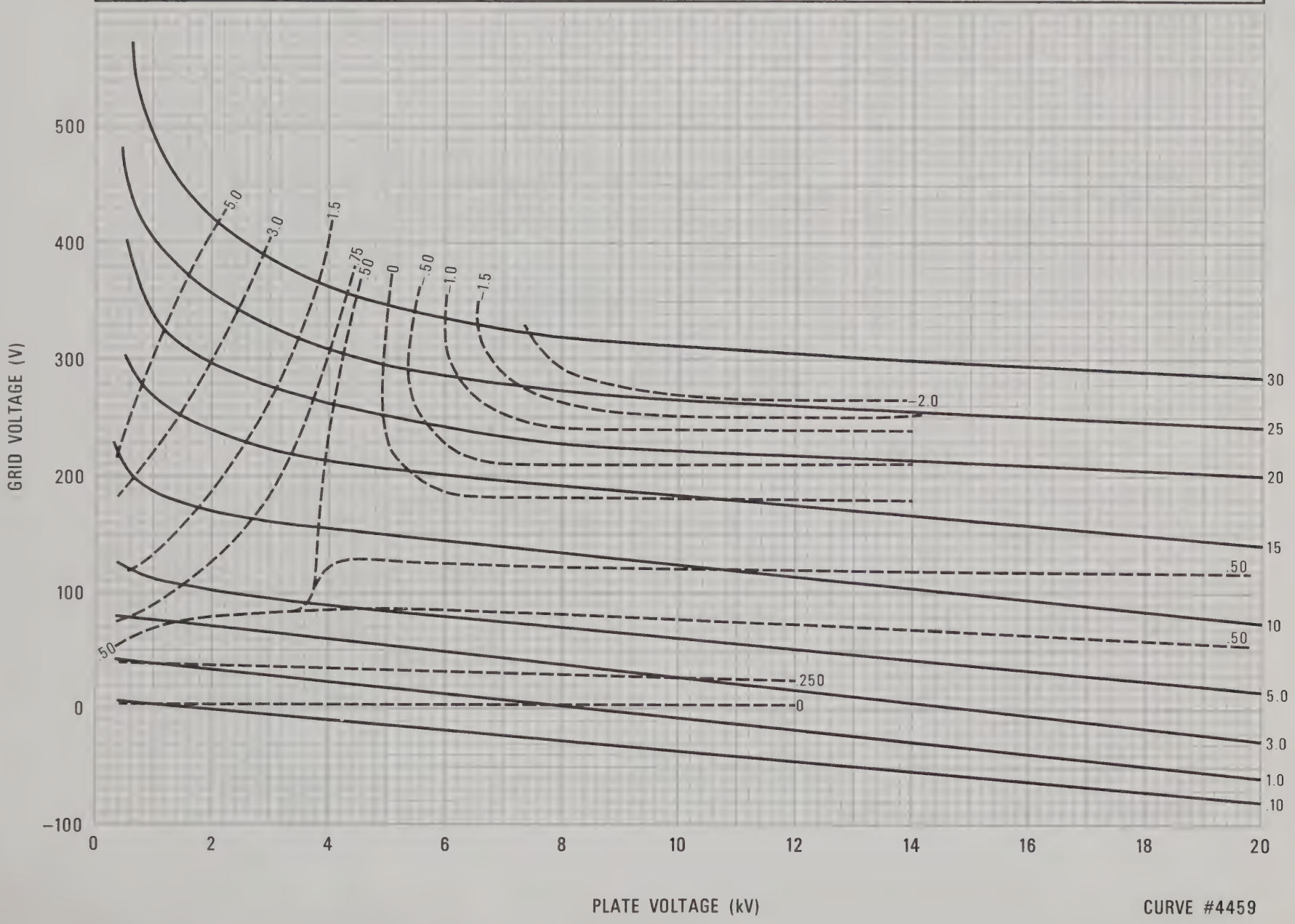
FAULT PROTECTION - In addition to normal plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

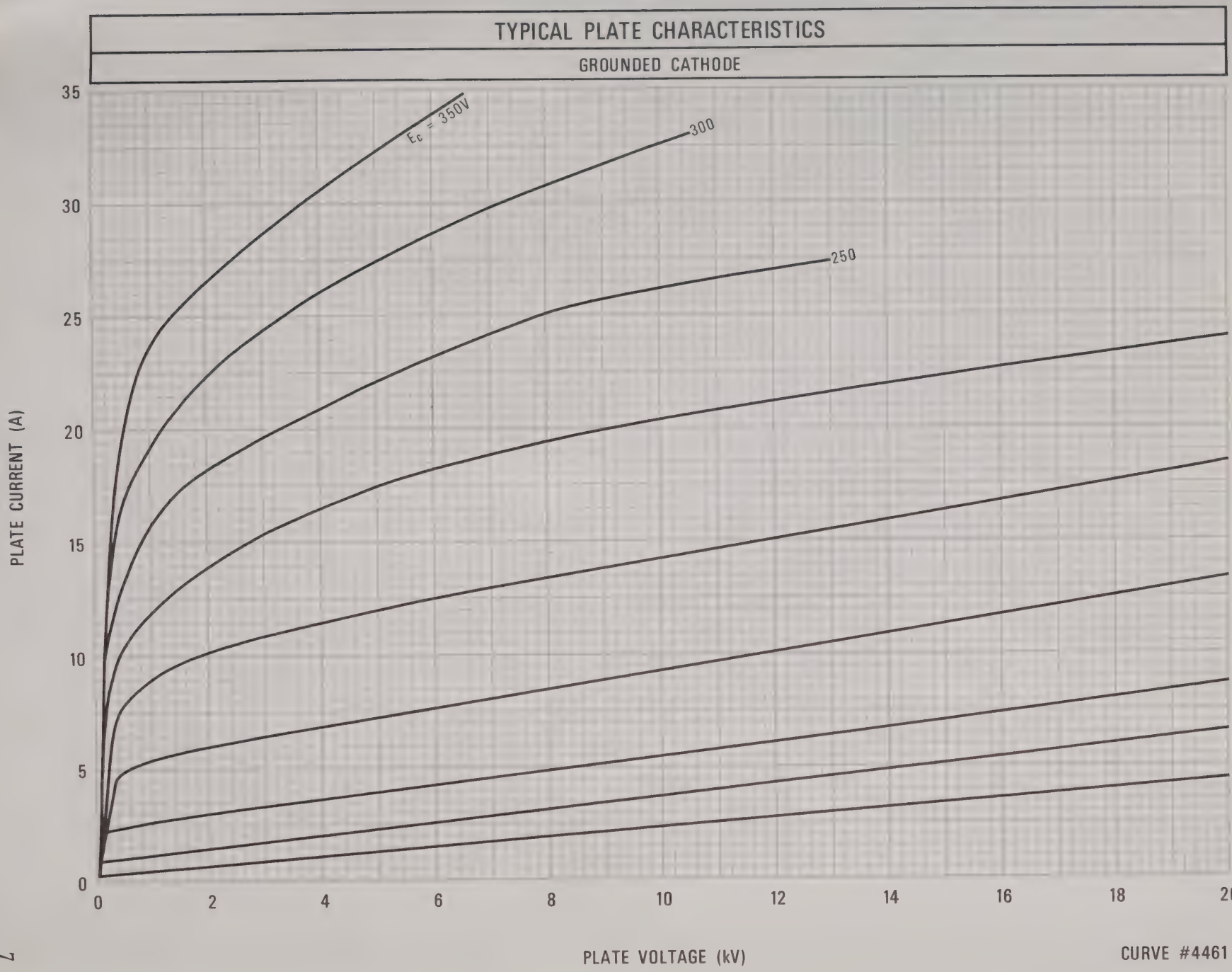
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

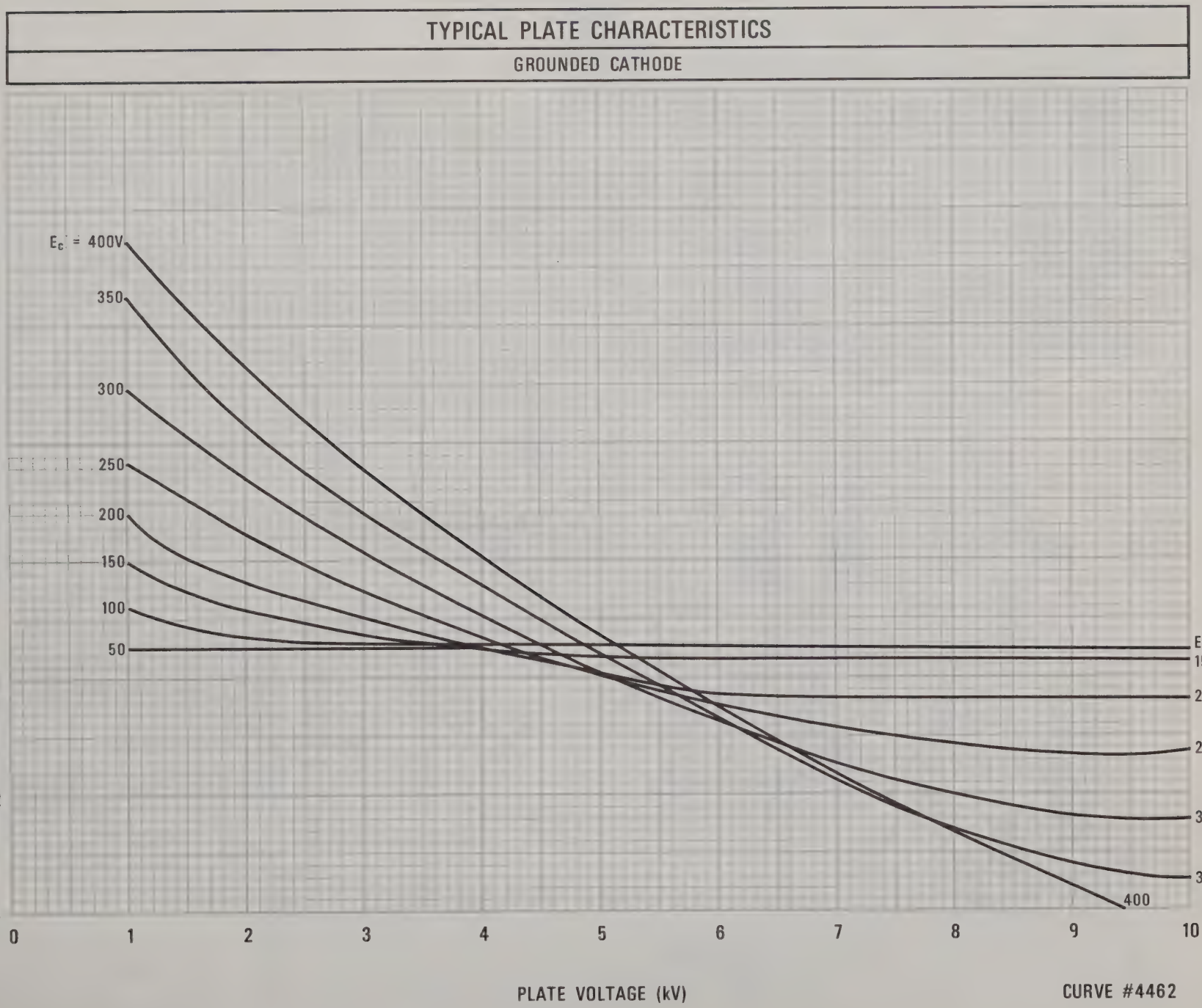
TYPICAL CONSTANT CURRENT CHARACTERISTICS

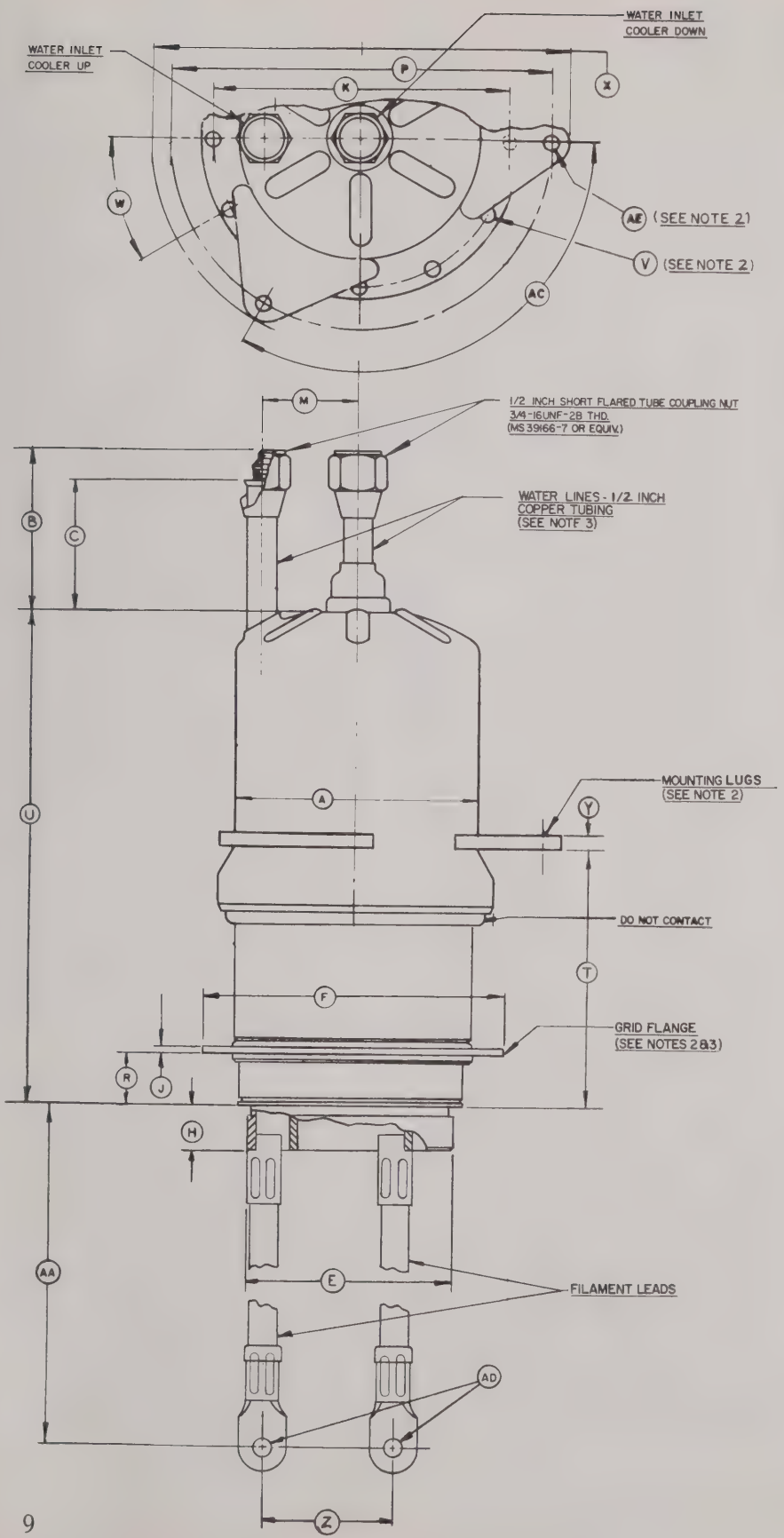
GROUNDED CATHODE



CURVE #4459


TYPICAL PLATE CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #4461
E_c = 350V
300
250
200
150
100
50
25
0
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12
14
16
18
20


TYPICAL PLATE CHARACTERISTICS
GROUNDED CATHODE
GRID CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #4462
E_c = 400V
350
300
250
200
150
100
50
E_c = 100V
150
200
250
300
350
400
10
8
6
4
2
0
−2
−4
0
1
2
3
4
5
6
7
8
9
10



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	2.312	2.812	- -	56.72	71.42	- -
C	1.937	2.187	- -	49.20	55.55	- -
E	3.230	3.270	- -	82.04	83.06	- -
F	5.030	5.090	- -	127.76	129.29	- -
H	0.530	0.700	- -	13.46	17.78	- -
J	- -	- -	0.125	- -	- -	3.18
K	4.425	4.445	- -	112.40	112.90	- -
M	1.500	1.750	- -	38.10	44.45	- -
P	5.957	6.025	- -	151.31	153.04	- -
R	0.700	0.860	- -	17.78	21.84	- -
T	4.350	4.450	- -	110.49	113.03	- -
U	7.903	8.403	- -	200.74	213.44	- -
V	- -	- -	0.250	- -	- -	6.35
W	29°	31°	- -	29°	31°	- -
X	- -	- -	6.750	- -	- -	171.45
Y	- -	- -	0.250	- -	- -	6.35
Z	- -	- -	2.000	- -	- -	50.80
AA	8.500	9.000	- -	215.90	228.60	- -
AC	118°	122°	- -	118°	122°	- -
AD	- -	- -	0.390	- -	- -	9.91
AE	- -	- -	0.265	- -	- -	6.73

NOTES:
1. REF DIMS ARE FOR INFO ONLY AND ARE NOT REQD FOR INSPECTION PURPOSES.
2. 3 MTG HOLES IN MTG LUGS & 12 IN THE GRID FLANGE.
3. GRID FLANGE, WATER FITTINGS, & FIL. LEADS ORIENTED AS SHOWN.

TECHNICAL DATA

SK-620
SK-620A
AIR-SYSTEM SOCKET

The EIMAC SK-620 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-626 Air Chimney or a fiberglass-reinforced EIMAC resin SK-636 Air Chimney are also available and are recommended for use with the socket when air-cooled tubes are to be employed, except the 8930.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-620 Air-System Socket is humidity and salt-spray resistant. The SK-620A is an improved SK-620 which includes a slightly modified screen by-pass capacitor sealed with an improved encapsulating material to insure reliable performance under high humidity or moisture conditions.



BASE CONNECTIONS

The SK-620 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance; these terminal lugs are insulated from the socket body.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low-inductance screen by-pass capacitor, 1100 pF ±20%, which provides a short radio-frequency path to ground. The silvered-mica dielectric, encapsulated in epoxy resin, is humidity and salt-spray resistant. The sockets are hi-voltage tested at 2000 volts dc and are rated for use at 1000 volts dc.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT (Approximate) . . . . . 4 oz.; 114 gms

INSTALLATION

The SK-620 and SK-620A Air-System Sockets can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-¼″ diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-⅝″ diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

TUBE EXTRACTOR

The SK-604 is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-620 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

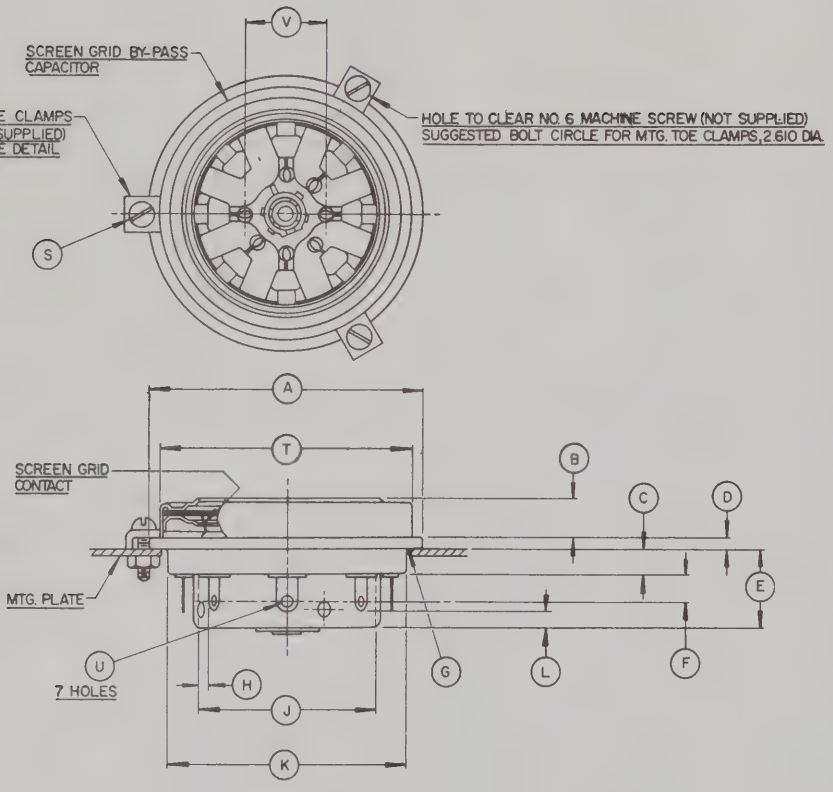
THE SK-620 AND SK620A AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	8249/4W300B	8904/4CX350FJ
7203/4CX250B	8321/4CX350A	8930
7580W/4CX250R	8322/4CX350F	8957/4CX250BC
7609	8621/4CX250FG	

(Revised 7-1-75) © 1961, 1967, 1975 by Varian

Printed in U.S.A.

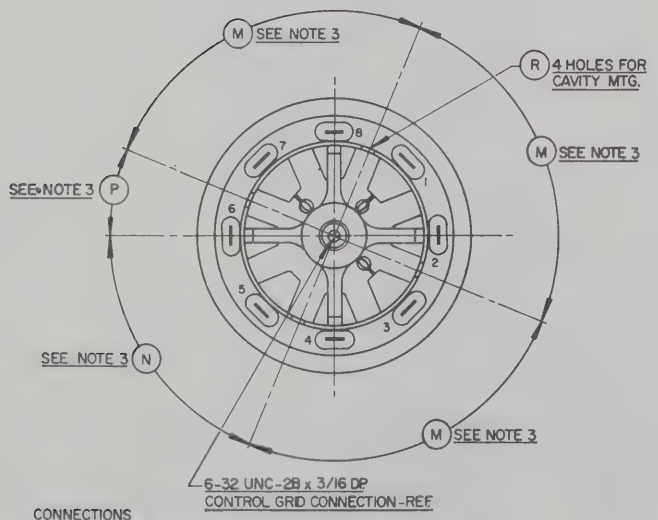
SK-620/620A



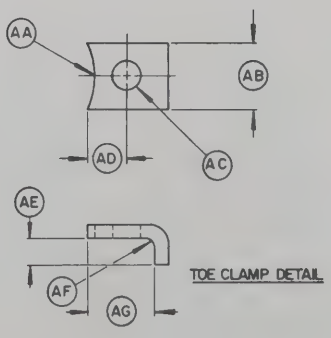
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.438	2.478	- -	61.92	62.94	- -
B	0.348	0.378	- -	8.84	9.60	- -
C	0.203	0.235	- -	5.16	5.97	- -
D	0.105	0.145	- -	2.67	3.68	- -
E	0.700	0.740		17.78	18.80	- -
F	- -	- -	0.250	- -	- -	6.35
G	- -	0.031R	- -	- -	0.79R	- -
H	- -	- -	0.078	- -	- -	1.98
J	1.633	1.643	- -	41.48	41.73	- -
K	2.188	2.208	- -	55.57	56.08	- -
L	0.172	0.204	- -	4.37	5.18	- -
M	89°	91°	- -	89°	91°	- -
N	66.5°	68.5°	- -	66.5°	68.5°	- -
P	21.5°	23.5°	- -	21.5°	23.5°	- -
R	- -	- -	0.144*	- -	- -	3.66*
S	0.142*	- -	- -	3.61*	- -	- -
T	2.285	2.305	- -	58.04	58.55	- -
U	- -	- -	0.090*	- -	- -	2.29*
V	- -	- -	0.687	- -	- -	17.45
AA	1.230R	1.270R	- -	31.24	32.26	- -
AB	0.292	0.332	- -	7.42	8.43	- -
AC	0.142*	0.146*	- -	3.61*	3.71*	- -
AD	0.136	0.176	- -	3.45	4.47	- -
AE	0.105	0.145	- -	2.67	3.68	- -
AF	- -	0.062R	- -	- -	1.57R	- -
AG	0.261	0.301	- -	6.63	7.64	- -

* DIAMETER

NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSPECTION PURPOSES.
2. CAPACITANCE, 1100 MMFD ±20% VOLTAGE, 2000 VDC TEST, 1000 WVDC.
3. TOLERANCES ARE NOT CUMULATIVE.
4. WORD EIMAC IN SOCKET IDENTIFICATION LABEL IS LOCATED (APPROX.) NEXT TO PIN 5.



CONNECTIONS
NO. 1 SCREEN GRID
NO. 2 CATHODE
NO. 3 HEATER
NO. 4 CATHODE
NO. 5 NO CONNECTION
NO. 6 CATHODE
NO. 7 HEATER
NO. 8 CATHODE



TOE CLAMP DETAIL

SK-640

AIR-SYSTEM SOCKET

The EIMAC SK-640 is one of the air system sockets recommended for use with those tubes listed at bottom of the page, or other tube types having the same special nine-pin base, when an integral screen by-pass capacitor is either not required or desired. When this socket is used,connection is made to each of the tube electrodes except the anode. The SK-640 Air-System Socket is humidity and salt-spray resistant. SK-606 Air Chimney is used with most air cooled tubes.



BASE CONNECTIONS

The SK-640 Air-System Socket consists of seven base pin contacting terminals (no contact is made to Pin #5) and a center control-grid terminal. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are insulated from the socket body. Connection to the screen-grid is made via Pin #1 while control-grid contact is accomplished by the use of a 6/32'' screw at the center terminal.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is nickel-plated brass and the base pin contact terminals are fabricated from beryllium-copper, heat treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass.

The socket insulating material, polytriflourochloroethylene, is chemically inert, non-flammable, will not absorb water or water-vapors and is not affected by acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of -196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT (Approximate) . . . . . 2.0 Oz. 57 gms

INSTALLATION

The SK-640 Air-System Socket can be mounted on a chassis decks or partitions by the four 0.150 inch diameter holes provided in the socket body. These holes are 90° apart and are drilled on a 2-9/16'' diameter pitch circle. A 2-1/4'' hole is required to accept the socket body.

TUBE EXTRACTOR

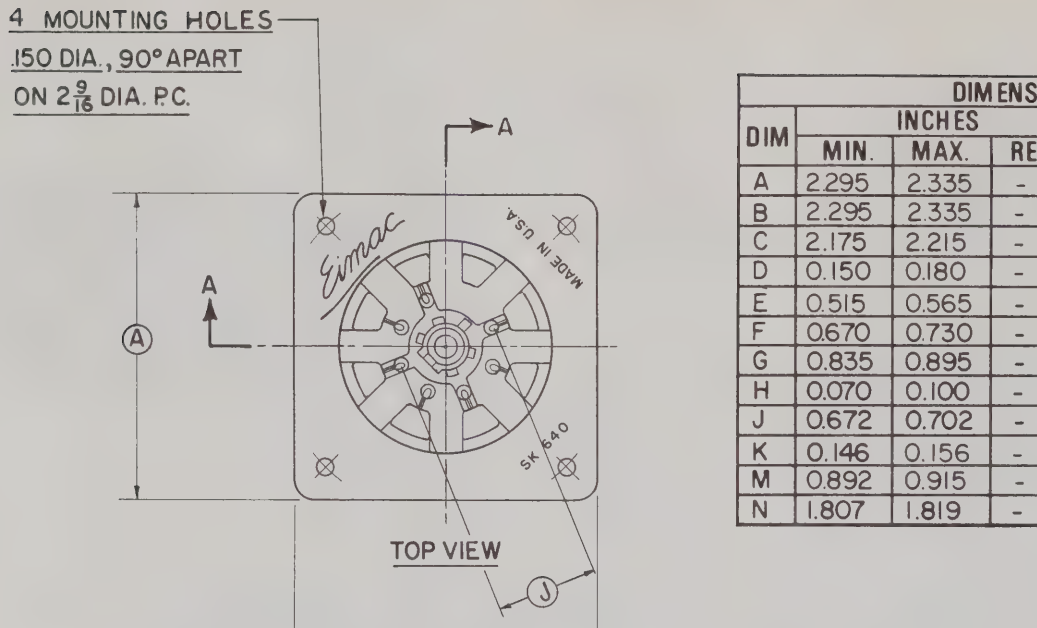
The SK-640A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-640 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-640 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

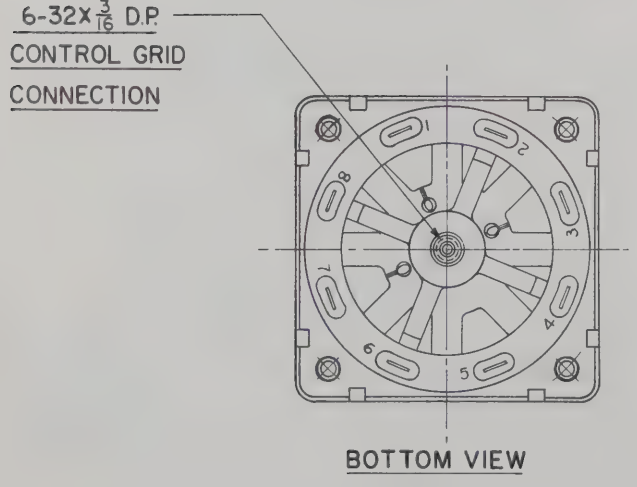
7034/4X150A	8249/4W300B	8904/4CX350FJ
7203/4CX250B	8321/4CX350A	8930
7580W/4CX250R	8322/4CX350F	8957/4CX250BC
7609	8621/4CX250FG	

(Revised 7-1-75) © 1961, 1966, 1975 by Varian Printed in U.S.A.

SK-640 Air-System Socket



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.295	2.335	- -	58.29	59.31	- -
B	2.295	2.335	- -	58.29	59.31	- -
C	2.175	2.215	- -	55.24	56.26	- -
D	0.150	0.180	- -	3.81	4.57	- -
E	0.515	0.565	- -	13.08	14.35	- -
F	0.670	0.730	- -	17.02	18.54	- -
G	0.835	0.895	- -	21.21	22.73	- -
H	0.070	0.100	- -	1.78	2.54	- -
J	0.672	0.702	- -	17.07	17.83	- -
K	0.146	0.156	- -	3.71	3.96	- -
M	0.892	0.915	- -	22.66	23.24	- -
N	1.807	1.819	- -	45.90	46.20	- -



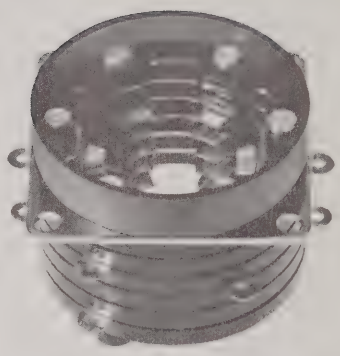
CONNECTIONS
1. SCREEN GRID
2. CATHODE
3. HEATER
4. CATHODE
5. NO CONNECTION
6. CATHODE
7. HEATER
8. CATHODE

Printed in U.S.A. 990

TECHNICAL DATA

SK-760
SK-770

AIR-SYSTEM SOCKETS



The EIMAC SK-760 and SK-770 Air-System Sockets are recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. These sockets incorporate a built-in integral chimney. When these sockets are used, connection is made to each of the tube electrodes except the anode. The screen contacts on the SK-760 are not connected to the metal mounting plate, while the screen contacts on the SK-770 are connected to the metal mounting plate. The SK-760 has no grounded contacts.

BASE CONNECTIONS

The SK-760 and SK-770 Air-System Sockets consist of five sets of ring contacts. They are (from top to bottom): 1)-screen-grid, 2)-control-grid, 3)-cathode, 4)-heater, 5)-heater. Each set of contacts consist of six separate contact tabs. The tube elements are connected to their external circuits by two diametrically opposed solder terminals.

MATERIALS AND FINISHES

The mounting plates of these sockets are fabricated of nickel-plated brass. Contact rings and tabs are made of beryllium copper, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the sockets are molded of a flameproof diallyl meta-phthalate.

INSTALLATION

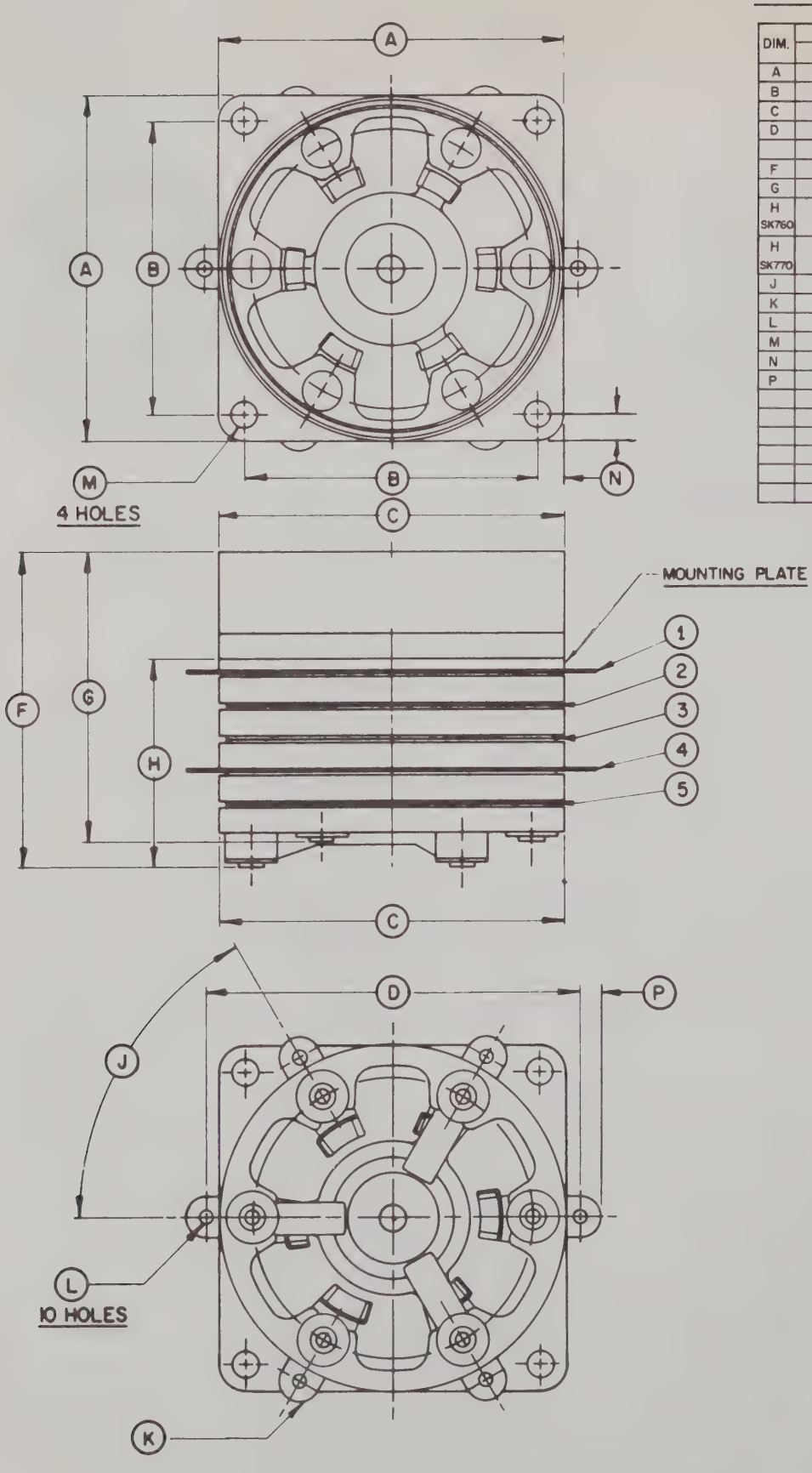
The SK-760 and SK-770 Air-System Sockets were designed for under-chassis mounting and require a 1.593 inches diameter hole through the chassis deck. Four screw holes are provided for fastening as shown on the outline drawing.

THE SK-760 AND SK-770 AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBE TYPES:

4CN15A 4CX300A/8167 4CX300Y/8561

NET WEIGHT (Approximate) . . . . . 1.5 oz; (42.5 gm)

(Revised 7-15-75) © 1963, 1966, 1970, 1975 by Varian Printed in U.S.A.



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.615	1.635	- -	41.00	41.40	- -
B	1.360	1.390	- -	34.57	35.25	- -
C	1.615 D.	1.635 D.	- -	41.00 D.	41.40 D.	- -
D	1.735	1.765	- -	43.90	44.83	- -
F	1.330	1.370	- -	33.75	34.80	- -
G	1.205	1.245	- -	30.60	31.66	- -
H SK760	1.020	1.060	- -	25.91	26.92	- -
H SK770	.931	.971	- -	23.70	24.70	- -
J	- -	- -	60°	- -	- -	60°
K	- -	- -	3/32 R.	- -	- -	2.38 R.
L	- -	- -	1/16 D.	- -	- -	1.59 D.
M	.134 D.	.154 D.	- -	3.40 D.	3.92 D.	- -
N	.120	.130	- -	3.05	3.30	- -
P	.078	.109	- -	1.98	2.77	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

CONNECTIONS
1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER

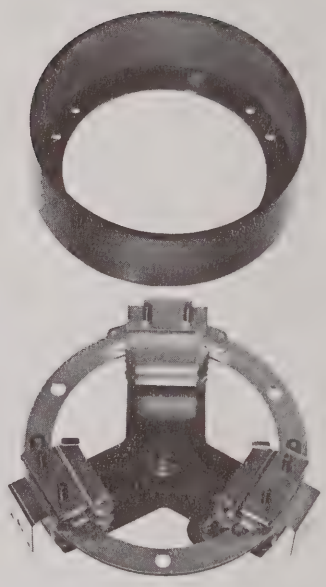
TECHNICAL DATA

SK-816
SK-860
SK-870

AIR-SYSTEM SOCKET and CHIMNEY

The EIMAC SK-860 and SK-870 are air-system sockets recommended for use with the EIMAC 3CX1000A7 triode. A companion SK-816 Air Chimney is also available and is recommended for use with the socket.

When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-860 and SK-870 are humidity and salt-spray resistant.



BASE CONNECTIONS

The SK-860 and SK-870 sockets consist of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact) and a center guide to facilitate tube installation. The terminals are shown on the outline drawing.

No contacts are grounded on the SK-860, while the SK-870 has the grid contacts grounded to the equipment chassis when installed.

MATERIALS and FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base is a one-piece nickle-plated die casting. All contacts are formed of a non-ferrous alloy, heat treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-860 and SK-870 are designed for under-chassis mounting and require a 2-3/4'' diameter hole through the chassis deck. The socket is held in place by the six 4-40 studs provided on the socket. The grid of the SK-870 is automatically grounded to the chassis when this mounting method is used.

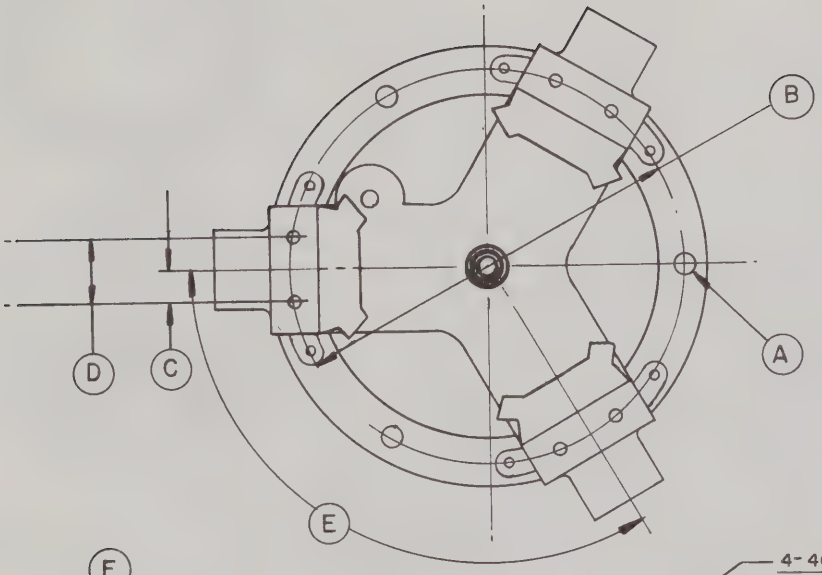
AIR CHIMNEY

The SK-816 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-860 and SK-870.

NET WEIGHT ..... 12 oz; 340 gms

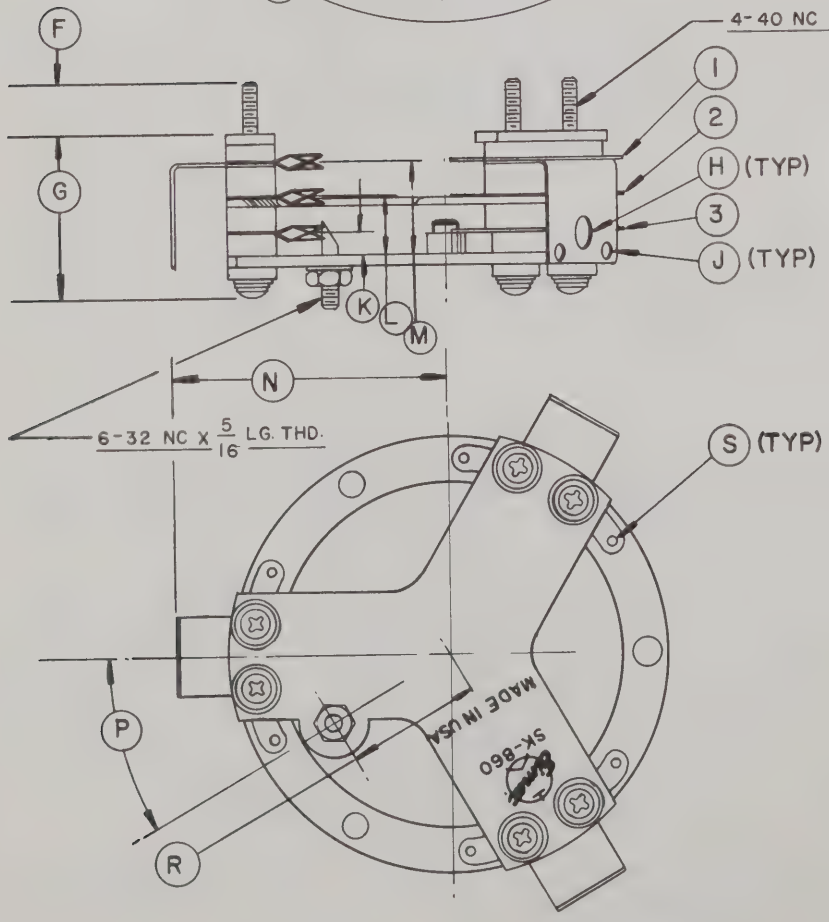
(Revised 3-25-75) © 1963, 1967, 1975 by Varian

Printed in U.S.A.



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	0.160	0.180	- -	4.06	4.57	- -
B	3.040	3.085	- -	77.22	78.36	- -
C	0.234	0.266	- -	5.94	6.76	- -
D	0.484	0.516	- -	12.29	13.11	- -
E	119°	121°	- -	119°	121°	- -
F	- -	- -	0.270	- -	- -	6.86
G	1.215	1.295	- -	30.86	32.89	- -
H	- -	- -	0.170	- -	- -	4.32
J	- -	- -	0.092	- -	- -	2.34
K	0.160	0.180	- -	4.06	4.57	- -
L	0.430	0.460	- -	10.92	11.68	- -
M	0.690	0.735	- -	17.53	18.67	- -
N	- -	- -	1.985	- -	- -	50.42
P	29°	31°	- -	29°	31°	- -
R	- -	- -	1.062	- -	- -	26.97
S	- -	- -	0.066	- -	- -	1.68

NOTE: REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



NOTE

1. GRID
2. CATHODE HEATER
3. HEATER

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

POWER GRID TUBE SELECTION GUIDE

(Effective 2-15-75) © by Varian

Printed in U.S.A.

POWER GRID TUBE SELECTION GUIDE

The EIMAC Power Grid Tube Selection Guide is arranged for ease in making type selections by use rather than tube type. The Guide is applications-oriented.

Tube types are listed according to the principle modes of service for which they are rated. Under each mode of service, EIMAC tube types suitable for the application are tabulated in descending order of the most significant tube parameter in the left hand column. For example, in the POWER AMPLIFIER tabulation, tube types are listed in descending order of typical rf power output; PULSE REGULATOR tubes are listed in descending order of peak current capability. This format places emphasis on tube application and facilitates comparison in terms of the significant ratings of the EIMAC types available for a given application.

After preliminary selection of a tube type (or types) from the Guide, the final choice should be based upon the complete ratings from the EIMAC data sheet for the tube in question and consultation with the EIMAC Application Engineering Department.

RADIO FREQUENCY POWER AMPLIFIER

Linear Service

Peak Env. Power‡ Typical (kW)	Rated Anode Diss. (kW)	Frequency* F1 / upper useful (MHz)	Inter-Mod. Distortion Typical† 3rd (dB)	5th (dB)	Cooling	EIMAC Type Number	Tube Type
1180	1250	30 / 50	—	—	water	X-2159	Tetrode
600	650	50 / 100	—	—	water	X-2170	Tetrode
230	250	30 / 50	−31	−43	vapor	4CV250,000A	Tetrode
230	250	30 / 50	−31	−43	water	4CW250,000A	Tetrode
168	100	108 / 150	—	—	water	4CW100,000E	Tetrode
123	100	30 / 50	−26	−40	vapor	4CV100,000C	Tetrode
105	50	110 / 220	—	—	vapor	3CV50,000A7	Triode[1]
55	35	30 / 50	−30	−40	air	4CX35,000C	Tetrode
45	50	110 / 200	−46	−60	vapor	4CV50,000J	Tetrode
45	50	110 / 200	−46	−60	water	4CW50,000J	Tetrode
27.5	20	250 / 500	—	—	air	8963	Triode[2]
27.5	20	110 / 220	—	—	air	3CX20,000A7	Triode[1]
17	15	110 / 220	−40	−39	air	3CX15,000A7	Triode[1]
17	20	140 / 220	−40	−39	water	3CW20,000A7	Triode[1]
17	10	140 / 220	−40	−39	air	3CX10,000A7	Triode[1]
14	10	100 / 220	−30	−36	air	4CX10,000D	Tetrode
12	15	110 / 220	−41	−41	air	4CX15,000J	Tetrode
10.5	10	100 / 220	−35	−40	air	4CX10,000J	Tetrode
10	5	100 / 220	−30	−38	air	4CX5000A	Tetrode
10	5	100 / 220	−30	−38	air	4CX5000R	Tetrode
5.8	3	150 / 220	−40	−43	air	5CX3000A	Pentode
5.3	5	30 / —	−26	−40	air	290	Pentode
5.5	3	110 / —	−51	−45	air	3CX3000A7	Triode[1]
5.3	3	150 / 220	−32	−36	air	4CX3000A	Tetrode
5.8	3	30 / —	−26	−41	air	264/8576	Pentode
3.3	5	100 / 220	−41	−44	air	4CX5000J	Tetrode
2.06	1	220 / 400	−31	−39	air	3CX1000A7	Triode[1]

‡ Plate power output, calculated or measured at low frequency.

* F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

† Calculated or measured by two-tone method at 2.0 MHz.

1. Grounded grid 2. VHF TV

Peak Env. Power‡ Typical (Watts)	Rated Anode Diss. (Watts)	Frequency* F1/ upper useful (MHz)	Inter-Mod. Distortion Typical† 3rd (dB)	5th (dB)	Cooling	EIMAC Type Number	Tube Type
2050	1500	220 / 400	–38	–44	air	3CX1500A7	Triode[1]
2030	1500	500 / —	–44	–44	air	8938	Triode[1]
1785	1500	110 / 220	–33	–42	air	5CX1500A	Pentode
1160	1000	110 / 220	–43	–47	air	4CX1500B	Tetrode
1080	1000	110 / —	–29	–37	air	3-1000Z	Triode[1]
940	500	110 / —	–40	–45	air	3-500Z	Triode[1]
645	500	110 / -	–33	–41	air	5-500A	Pentode
590	200	500 / 900	–35	–36	conduction	8873	Triode[1]
590	400	500 / 900	–35	–36	air	8874	Triode[1]
590	300	500 / 900	–35	–36	air	8875	Triode[1]
590	400	110 / —	–28	–35	air	3-400Z	Triode[1]
580	600	30 / —	–43	–43	air	4CX600J	Tetrode
495	400	110 / —	—	—	air	4-400C	Tetrode
350	350	500 / —	–27	–50	air	8930	Tetrode
295	250	500 / —	–25	–30	air	4CX250R	Tetrode
295	250	500 / —	–25	–30	conduction	4CS250R	Tetrode
263	350	30 / 220	–30	–35	air	4CX350A	Tetrode
263	350	30 / 220	–30	–35	air	4CX350F	Tetrode
263	350	30 / 220	–40	–45	air	4CX350FJ	Tetrode
226	200	500 / —	—	—	conduction	8560A	Tetrode

‡ Plate power output, calculated or measured at low frequency.

* F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

† Calculated or measured by two-tone method at 2.0 MHz.

1. Grounded grid

RF POWER AMPLIFIER

Class C, CW or FM Service

Plate Pwr. Output Typical* (kW)	Rated Plate Diss. (kW)	Freq.† F1/ upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
1650	1250	30 / 50	x200	water	X-2159	Tetrode
1050	650	50 / 100	x300	water	X-2170	Tetrode
460	250	30 / 50	x150	vapor	4CV250,000A	Tetrode
460	250	30 / 50	x150	water	4CW250,000A	Tetrode
220	100	108 / 150	x1800	water	4CW100,000E	Tetrode
168	100	30 / 50	x1350	vapor	4CV100,000C	Tetrode
165	100	30 / 50	x140	water	4CW100,000D	Tetrode
137	50	110 / 220	x900	vapor	4CV50,000E	Tetrode
137	50	110 / 220	x900	water	4CW50,000E	Tetrode
110	35	30 / 50	x425	air	4CX35,000C	Tetrode
80	60	40 / 80	x130	water	6696A	Triode
80	80	40 / 80	x130	vapor	7480	Triode
80	35	40 / 80	x130	air	6697A	Triode
64	20	90 / 150	x66	air	3CX20,000A3	Triode
64	20	90 / 150	x66	air	3CX20,000H3	Triode
42	25	100 / 150	x37	water	3CW25,000A3	Triode
36.5	15	110 / 225	x166	air	4CX15,000A	Tetrode
30.0	15	100 / 150	x45	air	3CX15,000A3	Triode
25.0	15	110 / 160	x50	air	3CX15,000A7	Triode
24.5	10	140 / 200	x6	air	3CX10,000A3	Triode[1]
24.5	20	140 / 200	x6	water	3CW20,000A3	Triode[1]
16	5	100 / 220	x1050	air	4CX5000A	Tetrode

* Power output and power gain are calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

1. Grounded grid

RF FREQUENCY POWER AMPLIFIER—CLASS C, CW or FM, CONTINUED

Plate Pwr. Output Typical* (Watts)	Rated Plate Diss. (Watts)	Frequency† F1/ upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
16,000	10,000	100 / 220	x1050	air	4CX10,000D	Tetrode
16,000	10,000	100 / 220	x1050	water	4CW10,000A	Tetrode
16,000	5000	100 / 220	x1050	air	4CX5000R	Tetrode
11,000	3000	150 / 220	x260	air	4CX3000A	Tetrode
10,000	4000	75 / 150	x73	air	3CX2500A3	Triode
10,000	4000	75 / 150	x73	air	3CX2500F3	Triode
10,000	5000	75 / 150	x73	water	3CW5000A3	Triode
10,000	5000	75 / 150	x73	water	3CW5000F3	Triode
8500	3000	150 / 220	x160	air	5CX3000A	Pentode
3400	1000	110 / —	x225	air	4-1000A	Tetrode
3200	1500	110 / 220	x350	air	4CX1500A	Tetrode
3180	1500	110 / 220	x350	air	5CX1500A	Pentode
2600§	1500	250 / —	x33	air	3CX1500A7	Triode[1]
1500§§	1500	500 / —	x30	air	8938	Triode[1]
1265	500	110 / —	x140	air	4-500A	Pentode
1100	400	110 / —	x190	air	4-400C	Tetrode
1000	250	110 / —	x190	air	4-250A	Tetrode
840	350	100 / 150	x31	air	5867A	Triode
805	250	60 / —	x9	air	6569	Triode[1]
805	500	110 / —	x67	air	4-500A	Tetrode
745	400	60 / —	x8	air	6580	Triode[1]
680	1500	— / 900	x10	air	8962	Triode[2]
600	300	110 / 220	x158	air	4CX300Y	Tetrode
500	300	500 / —	x177	air	4CX300A	Tetrode
450	350	500 / —	—	air	8930	Tetrode
380	250	500 / —	x190	conduction	4CS250R	Tetrode
380	250	500 / —	x130	air	4CX250BC	Tetrode
380	250	500 / —	x130	air	4CX250FG	Tetrode
380	250	500 / 1500	x130	air	4CX250K	Tetrode
380	250	500 / 1500	x130	air	4CX250M	Tetrode
380	250	500 / —	x190	air	4CX250R	Tetrode
380	250	150 / 500	x130	air	4X150A	Tetrode
380	250	150 / 500	x130	air	7609	Tetrode
380	250	500 / —	x130	conduction	8560A	Tetrode
375	125	120 / —	x150	air	4-125A	Tetrode
320	200	500 / —	x35	conduction	8873	Triode
320	400	500 / —	x35	air	8874	Triode
320	300	500 / —	x35	air	8875	Triode
270	65	150 / —	x160	convection	4-65A	Tetrode
216	400	1000 / —	11.5	air	3CX400U7	Triode[2]
100	115	1215 / —	x27 @ 400 MHz	air	6816	Tetrode
100	115	1215 / —	x27 @ 400 MHz	air	6884	Tetrode
100	115	1215 / —	x27 @ 400 MHz	air	7457	Tetrode
100	115	1215 / —	x27 @ 400 MHz	conduction	7843	Tetrode

* Power output and power gain are calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

§ Power output shown is measured useful, delivered to load, at 104 MHz. §§ Useful power output, measured at 430 MHz

1. Grounded grid 2. 900 MHz

RF POWER AMPLIFIER

Class C — Plate Modulated Service

Carrier Pwr. Output Typical* (kW - W)	Plate Diss. at Typical Conditions (kW - W)	Frequency† F1 / upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
1375 kW	800 kW	30 / 50	x200	water	X-2159	Tetrode
700 kW	160 kW	50 / 100	x290	water	X-2170	Tetrode
285 kW	119 kW	30 / 50	x120	vapor	4CV250,000A	Tetrode
285 kW	119 kW	30 / 50	x120	water	4CW250,000A	Tetrode
140 kW	47 kW	30 / 50	x110	vapor	4CV100,000C	Tetrode
140 kW	35 kW	108 / 150	x260	water	4CW100,000E	Tetrode
138 kW	22 kW	30 / 50	x160	water	4CW100,000D	Tetrode
110 kW	22 kW	110 / 220	x160	water	4CW50,000E	Tetrode
110 kW	22 kW	110 / 220	x160	vapor	4CV50,000E	Tetrode
60 kW	20 kW	40 / 80	x30	water	6696A	Triode
60 kW	20 kW	40 / 80	x30	air	6697A	Triode
60 kW	20 kW	40 / 80	x30	vapor	7480	Triode
55 kW	13 kW	30 / 50	x440	air	4CX35,000C	Tetrode
27.5 kW	7.5 kW	90 / 150	x18	air	3CX20,000A3	Triode
27.5 kW	7.5 kW	90 / 150	x18	air	3CX20,000H3	Triode
23.5 kW	5.8 kW	110 / 225	x155	air	4CX15,000A	Tetrode
23.5 kW	5.8 kW	110 / 225	x155	vapor	4CV35,000A	Tetrode
18.0 kW	5.4 kW	100 / 150	x37	air	3CX15,000A3	Triode
12.4 kW	2.6 kW	140 / 200	x24	air	3CX10,000A3	Triode
8500 W	3500 W	100 / 220	x230	air	4CX10,000D	Tetrode
8500 W	3500 W	100 / 220	x230	air	4CX5000A	Tetrode
8500 W	3500 W	100 / 220	x230	air	4CX5000R	Tetrode
5750 W	1250 W	150 / 220	x190	air	4CX3000A	Tetrode
5300 W	950 W	75 / 150	x45	air	3CX2500A3	Triode
5300 W	950 W	75 / 150	x45	air	3CX2500F3	Triode
2630 W	670 W	110 / —	x290	air	4-1000A	Tetrode
2320 W	780 W	110 / 220	x230	air	4CX1500A	Tetrode
1960 W	575 W	110 / 220	x195	air	5CX1500A	Pentode
1765 W	485 W	110 / —	x50	air	3-1000Z	Triode
830 W	245 W	110 / —	x140	air	4-500A	Tetrode
785 W	280 W	110 / —	x110	air	5-500A	Pentode
640 W	185 W	110 / —	x25	air	3-500Z	Triode
630 W	195 W	110 / —	x190	air	4-400C	Tetrode
510 W	165 W	110 / —	x160	air	4-250A	Tetrode
300 W	80 W	120 / —	x90	air	4-125A	Tetrode
300 W	200 W	110 / 220	x175	air	4CX300 Y	Tetrode
270 W	280 W	500 / —	—	air	8930	Tetrode
235 W	65 W	500 / —	x160	conduction	4CS250R	Tetrode
235 W	65 W	500 / —	x135	air	4CX250BC	Tetrode
235 W	65 W	500 / —	x135	air	4CX250F	Tetrode
235 W	65 W	500 / 1500	x135	air	4CX250K	Tetrode
235 W	65 W	500 / 1500	x135	air	4CX250M	Tetrode
235 W	65 W	500 / —	x160	air	4CX250R	Tetrode
235 W	65 W	500 / —	x135	air	4CX300A	Tetrode
235 W	65 W	150 / 500	x135	air	4X150A	Tetrode
235 W	65 W	150 / 500	x135	air	7609	Tetrode
235 W	65 W	500 / —	x135	conduction	8560A	Tetrode
210 W	45 W	150 / —	x65	convection	4-65A	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	air	6884	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	air	7457	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	conduction	7843	Tetrode

* Power output and power gain are calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operating at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

RF POWER AMPLIFIER

Grid Pulsed Service

Peak RF Pwr. Output Typical β (kW)	Rated Anode Diss. (kW)	Frequency† F1 / upper useful (MHz)	Maximum Anode Voltage (kVdc)	Maximum Anode Current β (A)	Cooling	EIMAC Type Number	Tube Type
3900	1250	30 / 50	30	195	water	X-2159	Tetrode
2000	650	50 / 100	30	100	water	X-2170	Tetrode
1000	100	108 / 150	30	50	water	4CW100,000E	Tetrode
500	50	110 / 220	30	33	vapor	4CV50,000E	Tetrode
500	50	110 / 220	30	33	water	4CW50,000E	Tetrode
160	15	110 / 225	12	20	air	4CX15,000A	Tetrode
80	10	110 / 220	10	13	air	4CX10,000D	Tetrode
80	10	110 / 220	10	13	air	4CX5000A	Tetrode
80	10	100 / 220	10	13	air	4CX5000R	Tetrode
35	1.5	— / 500	20	8	air	3CPX1500A7	Triode
34	1.0	110 / —	15	3.5	air	4PR1000A	Tetrode
28*	0.25	500 / 1500	7	6.0	air	4CPX250K	Tetrode
28*	0.25	500 / 1500	7	6.0	air	4CX250K	Tetrode
28*	0.25	500 / 1500	7.0	6.0	air	4CX250M	Tetrode
26	1500	500 / —	5	8	air	8938	Triode
11	0.40	110 / —	10	1.7	air	4PR400A	Tetrode
10‡	0.25	500 / 1500	5.5	0.8	air	4CPX250K	Tetrode
4.0	0.125	120 / —	9.0	0.7	air	4PR125A	Tetrode
2.6	0.300	110 / 220	3.0	1.3	air	4CX300Y	Tetrode
2.0	0.065	150 / —	7.5	0.4	convection	4PR65A	Tetrode
1.6	0.20	500 / —	3.0	0.8	conduction	8873	Triode
1.6	0.40	500 / —	3.0	0.8	air	8874	Triode
1.6	0.30	500 / —	3.0	0.8	air	8875	Triode
1.6	0.25	500 / —	3.0	0.8	air	4CX250B	Tetrode
1.6	0.25	500 / —	3.0	0.8	air	4CX250F	
1.6	0.25	500 / 1500	3.0	0.8	air	4CX250K	Tetrode
1.6	0.25	500 / 1500	3.0	0.8	air	4CX250M	

β Average during the pulse. Power output data is anode power (does not include circuit losses), calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced anode power input.

* Anode and screen-grid pulsed

‡ Cathode driven, screen pulsed

OSCILLATOR OR AMPLIFIER

Class C — Industrial Service

Plate Pwr. Output Typical* (kW)	Rated Plate Diss. (kW)	Filament Heating Power (Watts)	Frequency† F1 / upper useful (MHz)	Cooling	EIMAC Type Number	Tube Type
1800	1000	26640	30 / 60	water	X-2176	Triode
900	500	13320	30 / 60	water	X-2177	Triode
80	60	2665	40 / 80	water	6696A	Triode
80	35	2665	40 / 80	air	6697A	Triode
80	80	2665	40 / 80	vapor	7480	Triode
70	40	1600	90 / —	water	3CW40,000H3	Triode
60	20	1600	90 / —	air	3CX20,000H3	Triode
42	30	1020	90 / —	water	3CW30,000H3	Triode
42	30	1020	100 / —	vapor	3CV30,000H3	Triode
41.2	15	1020	90 / —	air	3CX15,000H3	Triode
29	10	742	90 / —	air	3CX10,000H3	Triode
28	20	742	90 / —	water	3CW20,000H3	Triode
20.6	10	566	90 / —	water	3CW10,000H3	Triode
18.6	5	566	90 / —	air	3CX5000H3	Triode
10	5	379	75 / 150	water	3CW5000H3	Triode
5	2.5	379	75 / 150	air	3CX2500A3/F3/H3	Triode
1.2	0.3	125	40 / 80	air	304TL	Triode
0.68	0.35	70	100 / —	air	5867A	Triode

* Calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

AF POWER AMPLIFIER

OR

MODULATOR SERVICE

AF Pwr. Output Typical* (2 tubes) (kW - W)	Typical* Plate Diss. Per Tube (kW - W)	Class of Service	Driving Power (2 tubes)	Cooling	EIMAC Type Number	Tube Type
1900 kW	420 kW	AB1	0	water	X-2159	Tetrode
950 kW	210 kW	AB1	0	water	X-2170	Tetrode
660 kW	260 kW	AB1	0	vapor	4CV250,000A	Tetrode
660 kW	260 kW	AB1	0	water	4CW250,000A	Tetrode
246 kW	57 kW	AB1	0	vapor	4CV100,000C	Tetrode
246 kW	57 kW	AB1	0	water	4CW100,000D	Tetrode
200 kW	46 kW	AB1	0	water	4CW100,000E	Tetrode
195 kW	42 kW	AB1	0	water	4CW50,000E	Tetrode
195 kW	42 kW	AB1	0	vapor	4CV50,000E	Tetrode
195 kW	42 kW	AB1	0	vapor	4CV50,000J	Tetrode
195 kW	42 kW	AB1	0	water	4CW50,000J	Tetrode
152 kW	44 kW	AB2	600	water	6696A	Triode
152 kW	44 kW	AB2	600	air	6697A	Triode
152 kW	44 kW	AB2	600	vapor	7480	Triode
70 kW	20 kW	AB1	0	air	4CX35,000C	Tetrode
66 kW	20.5 kW	AB1	0	vapor	4CV35,000A	Tetrode
57 kW	14 kW	AB1	0	water	4CW25,000A	Tetrode
57 kW	14 kW	AB1	0	air	4CX15,000A	Tetrode
31.9 kW	9 kW	AB1	0	air	4CX10,000D	Tetrode
29.1 kW	10 kW	AB1	0	air	3CX10,000A1	Triode
29.1 kW	10 kW	AB1	0	water	3CW20,000A1	Triode
17.5 kW	4.2 kW	AB1	0	air	4CX5000A	Tetrode
17.5 kW	4.2 kW	AB1	0	air	4CX5000R	Tetrode
1.45 kW	4.75 kW	AB1	0	vapor	4CV8000A	Tetrode
13.0 kW	2.5 kW	B	113	water	3CW5000A3	Triode
13.0 kW	2.5 kW	B	113	air	3CX2500A3	Triode
13.0 kW	2.5 kW	B	113	air	3CX2500F3	Triode
13.0 kW	2.5 kW	B	113	water	3CW5000F3	Triode
11.4 kW	3.3 kW	AB1	0	air	4CX3000A	Tetrode
10.0 kW	2.95 kW	AB1	0	water	3CW5000A1	Triode
10.0 kW	2.95 kW	AB1	0	water	3CW5000F1	Triode
10.0 kW	2.95 kW	AB1	0	air	3CX3000A1	Triode
10.0 kW	2.95 kW	AB1	0	air	3CX3000F1	Triode
3.9 kW	900 W	AB2	4.7	air	4-1000A	Tetrode
3.22 kW	920 W	AB1	0	air	5CX1500A	Pentode
3.2 kW	920 W	AB1	0	air	4CX1500A	Tetrode
1.72 kW	500 W	AB1	0	air	4-500A	Tetrode
1.66 kW	458 W	AB1	0	air	5-500A	Pentode
1.75 kW	400 W	AB2	3.5	air	4-400C	Tetrode
1.42 kW	445 W	AB2	25	air	3-500Z	Triode
1.31 kW	340 W	B	26	air	3-400Z	Triode
1.04 kW	190 W	AB2	1.9	air	4-250A	Tetrode
800 W	225 W	AB1	0	air	4CX300A	Tetrode
780 W	350 W	AB1	0	air	8930	Tetrode
600 W	200 W	AB1	0	air	4CX250BC 4CX250F 4X150A 7609	Tetrode
400 W	125 W	AB2	1.0	air	4-125A	Tetrode
270 W	63 W	AB2	1.3	air	4-65A	Tetrode

* Measured in watts, unless otherwise specified.

VOLTAGE OR CURRENT

REGULATOR SERVICE

Maximum Pass Current (Adc)	Maximum Hold-off Voltage (kVdc)	Minimum Tube Drop (Vdc)	Rated Anode Diss. (kW)	Cooling	EIMAC Type Number	Tube Type
300	40	3000	1250	water	X-2159	Tetrode
150	40	2500	650	water	X-2170	Tetrode
50	40	4400	250	water	4CW250,000A	Tetrode
35	40	2700	100	water	4CW100,000E	Tetrode
30	40	3300	100	water	4CW100,000D	Tetrode
15	35	3000	50	water	4CW50,000E	Tetrode
15	40	2200	35	air	4CX35,000C	Tetrode
7.5	10	1500	20	water	3CW20,000A1	Triode
7.5	20	1200	20	water	3CW20,000A7	Triode
7	10	1300	12	air	3CX10,000A1	Triode
6	20	800	25	water	4CW25,000A	Tetrode
4	20	500	15	air	3CX15,000A7	Triode
4	15	2000	10	water	4CW10,000A	Tetrode
3	12	1300	5	water	3CW5000A1	Triode
2	12	1000	3	air	3CX3000F1	Triode
2	6	1000	2	water	4CW2000A	Tetrode
1	8	250	1.5	air	3CX1500A7	Triode
1	6	500	1	air	4CX1000A	Tetrode
1	6	500	0.8	water	4CW800B	Tetrode
1	6	500	0.8	water	4CW800F	Tetrode
0.8	4.5	300	0.4	air	8874	Triode
0.8	4.5	300	0.3	air	8875	Triode
0.8	4.5	300	0.2	convection	8873	Triode
0.6	30	500	1	air	4PR1000A	Tetrode
0.6	8	400	0.5	air	3-500Z	Triode
0.2	20	1800	0.4	air	4PR400A	Tetrode
0.2	50	1000	0.25	air	4PR250C	Tetrode
0.1	18	1200	0.125	air	4PR125A	Tetrode
0.1	15	500	0.065	convection	4PR65A	Tetrode

SWITCH TUBE OR

PULSED REGULATOR SERVICE

Peak Anode Current (A)	Maximum Hold-off Voltage (kVdc)	Rated Anode Diss. (kW)	Cooling	EIMAC Type Number	Tube Type
780	60	1250	water	X-2159	Tetrode
400	60	650	water	X-2170	Tetrode
300	40	250	water	4CW250,000A	Tetrode
150	75	35	air	Y-546	Tetrode[1]
150	75	100	water	Y-647	Tetrode[2]
150	40	100	water	4CW100,000D	Tetrode
150	75	100	water	Y-676	Tetrode[3]
150	40	100	water	4CW100,000E	Tetrode
150	40	35	air	4CX35,000C	Tetrode
130	25	60	water	6696A	Triode
130	25	35	air	6697A	Triode
100	50	5	air	X-2187	Triode[4]
100	35	50	water	4CW50,000E	Tetrode
100	35	50	vapor	4CV50,000E	Tetrode
70	20	25	water	4CW25,000A	Tetrode
60	20	15	air	4CX15,000A	Tetrode
60	30	15	air	Y-456	Tetrode[5]
50	30	25	water	Y-569	Tetrode[6]
40	15	10	air	4CX10,000D	Tetrode
40	18	5	air	Y-573	Pentode[7]
40	18	3	air	Y-574	Pentode[8]
40	20	6.0	water	Y-633	Tetrode[9]
40	20	20	water	3CW20,000A7	Triode
40	15	5	air	4CX5000A	Tetrode
40	15	5	air	4CX5000R	Tetrode
40	25	10	water	Y-442	Tetrode[10]
25	20	3	air	4CX3000A	Tetrode
25	20	1.5	air	3CPX1500A7	Triode
18	20	0.06	air	4PR60C	Tetrode
15	10	3	air	3CX3000F7	Triode
12	12	1	air	Y-575	Pentode[11]
12	4	0.6	air	4CX600B/F	Tetrode
12	4	0.8	water	4CW800B/F	Tetrode
12	25	0.75	air	8941	Planar Triode
12	20	0.75	air	8942	Planar Triode
12	6.5	0.75	air	8940	Planar Triode
10	50	1.0	air	8960	Tetrode
10	7	1.5	air	4CX1500A	Tetrode
8	30	1.0	air	4PR1000A	Tetrode
8	40	1.0	air	Y-364	Tetrode[12]
8	7.5 (oil)	0.6	air or oil	8954	Tetrode
6	12	0.15	air	Y-518	Planar Triode
6	7	0.25	air	4CPX250K	Tetrode
6	4	0.15	air	Y-519	Planar Triode
5	12	0.15	air	Y-540	Planar Triode

1. Specially processed 4CX35,000C
2. Specially processed 4CW100,000D
3. Specially processed 4CW100,000E
4. Focused oxide cathode
5. Specially processed 4CX15,000A
6. Prototype: 4CW25,000A
7. Specially processed Type 290
8. Specially processed Type 8576/264
9. Prototype: 4CX5000R
10. Specially processed 4CX5000R
11. Specially processed 8295A
12. Specially processed 4PR1000A

SWITCH TUBE OR PULSED REGULATOR SERVICE, CONTINUED

Peak Anode Current (A)	Maximum Hold-off Voltage (kVdc)	Rated Anode Diss. (Watts)	Cooling	EIMAC Type Number	Tube Type
5	10	150	air	8755	Planar Triode
5	4	150	air	8847	Planar Triode
5	3.5	100	air	7211	Planar Triode
5	3.5	150	air	8757	Planar Triode
5	3.5	100	air	8403	Planar Triode
4	50	250	air	4PR250C	Tetrode
4	20	400	air	4PR400A	Tetrode
3	10	400	air	Y-504	Triode[13]
3	4.5	100	air	7815RAL	Planar Triode
3	3.5	100	air	7815R	Planar Triode
3	3.5	100	air	7855	Planar Triode
3	3.5	150	air		Planar Triode
2.1	18	125	air	4PR125A	Tetrode
1.5	4.5	100	air	8745	Planar Triode
1.2	15	65	convection	4PR65A	Tetrode

13. Specially processed 3-400Z

EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

1 September 1975

TO EIMAC TUBE MANUAL HOLDERS

The enclosed new or revised data sheets, along with an updated Table of Contents and Index, are to be inserted in the appropriate section of your EIMAC tube manual, volumes I & II. Please use your Table of Contents as a guide.

VOLUME I	INSERT	REMOVE
General		
Table of Contents	9/01/75	1/15/75
Index	9/01/75	1/15/75
Triodes		
3CW30,000H7	2/01/75	-----
3CX1500A7/8877	7/01/75	8/01/73
VOLUME II		
Other Products		
SK620, SK620A	7/01/75	3/15/67
SK640	7/01/75	2/15/66
SK760, SK770	7/15/75	7/27/70
SK816, SK860, SK870	3/25/75	3/15/67

William I. Orr

William I. Orr
Manager, Technical Data

WIO/ad
Enclosures



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

9-1-75

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000F3/8243	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW20,000H7	T
3CW30,000H3	T
3CW30,000H7	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX400U7	T
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203 & 4CX250FG/8621	TET
4CX250BC/8957	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4X150A/7034 see 7609	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7609 see 4X150A/7034	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
8954	TET
8959	TET
8963	T
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-646 see SK-606	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-816	OP
SK-860 see SK-816	OP
SK-870 see SK-816	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
X-2159	TET
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

9-1-75

(Effective 9-1-75) © 1975 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 9-1-75
Index 9-1-75
EIMAC and JEDEC Cross Reference List 2-15-75
Power Grid Selection Guide 2-15-75
Varian/Eimac Electron Tube and Device Group Sales Offices 1-15-75
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-3-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 11-15-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 8-15-74
3-500Z 11-1-73
3-1000Z/8164 8-15-74
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 1-11-74
3CW5000F3/8243 . . . . . see 3CW5000A3
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW20,000H7 5-15-74
3CW30,000H3 11-1-68
3CW30,000H7 2-1-75
3CW40,000H3 8-1-67
3CX400U7/8961 8-1-74
3CX1000A7/8283 3-25-75
3CX1500A7/8877 7-1-75
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7480	11-1-68
8873/8874/8875	6-3-73
8938	5-15-73
8963	4-1-75

TETRODES

4-65A/8165	5-1-62
4-125A/4D21	6-1-67
4-250A/5D22	5-5-70
4-400A/8438	7-20-70
4-400C/6775	4-1-71
4-500A	3-10-72
4-1000A/8166	10-30-66
4CN15A	6-1-68
4CPX250K/8590	4-1-70
4CS250R	9-1-70
4CV8000A	3-15-71
4CV20,000A	6-1-68
4CV35,000A	5-15-66
4CV50,000E	5-1-70
4CV50,000J	7-15-71
4CV100,000C/8351	2-1-68
4CV250,000A	3-1-72
4CW800B/F	11-1-73
4CW2000A/8244	6-15-71
4CW10,000A/8661	4-15-63
4CW25,000A	2-1-72
4CW50,000E	7-1-70
4CW50,000J	7-15-71
4CW100,000D	7-1-67
4CW100,000E	9-1-70
4CW250,000A	3-1-71
4CX125C/F	6-1-67
4CX250B/7203 & 4CX250FG/8621	8-1-74
4CX250BC/8957	1-1-74
4CX250K/8245 & 4CX250M/8246	5-1-68
4CX250R/7580W	6-16-61
4CX300A/8167	8-30-66
4CX300Y/8561	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX350FJ/8904	9-1-71
4CX600B & 4CX600F	3-20-70
4CX600J/8809 & 4CX600JA/8921	8-15-71
4CX1000A/8168	5-1-70
4CX1000K/8352	8-20-66
4CX1500A	12-1-71
4CX1500B/8660	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	4-15-71
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	12-1-70
4W300B/8249	11-1-73
4X150A/7034 & 7609	8-1-74
4X150G/8172	10-15-73
4X500A	1-1-64
6816,6884,7843	11-15-71
7609	see 4X150A/7034
8560A	7-15-71
8876	6-15-71
8930	12-1-73
8954	6-1-74
8959	11-1-74
X2159	7-1-73

PENTODES

5-125B/4E27A	8-15-52
5-500A	5-1-68
5CX1500A	6-6-70
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

PULSE MODULATORS

4PR60C/8252W	6-30-71
4PR65A/8187	2-15-63
4PR125A/8247	3-15-64
4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6	4-4-70
Preformed Contact Finger Stock	6-15-71
HR Heat Dissipating Connectors	12-1-65
SK-300A	4-15-69
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73
SK-410	12-1-73
SK-500	3-15-67
SK-506, SK-516	4-15-69
SK-510	3-15-75
SK-600A, SK-610A	11-1-74
SK-606, SK-626, SK-636B, SK-646	11-1-74
SK-607	8-15-71

(Cont'd)

OTHER PRODUCTS

SK-620, SK-620A	7-1-75
SK-630, SK-630A	3-15-67
SK-640	7-1-75
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A, SK-712A	3-15-71
SK-740	8-15-66
SK-760, SK-770	7-15-75
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-816, SK-860, SK-870	3-25-75
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210	8-15-72

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8244
4CW2000A

CERAMIC POWER TETRODE

The EIMAC 8244/4CW2000A is a ceramic and metal, water cooled, radial-beam tetrode with a rated maximum plate dissipation of 2000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. The 4CW-2000A is also recommended for voltage or current regulator service. As a regulator, up to 6000 volts of tube drop or one ampere of plate current can be realized.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		μmhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	μμf
Output	11		13	μμf
Feedback			0.022	μμf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	μμf
Output	11		13	μμf
Feedback			0.004	μμf
Frequency for Maximum Ratings			110	MHz

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Vertical
Maximum Over-all Dimensions:	
Height	5.54 inches
Diameter	2.66 inches
Net Weight	27 ounces

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB or B
(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	2000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	250	250	250	mA
Single-Tone DC Plate Current	890	885	875	mA
Two-Tone Average DC Plate Current	645	650	635	mA
Zero-Signal DC Screen Current*	8	6	5	mA
Single-Tone DC Screen Current*	35	35	35	mA
Two-Tone Average DC Screen Current*	10	8	8	mA
Plate Output Power	930	1300	1630	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

(Revised 6-15-66) © 1963, 1966 Varian

Printed in U.S.A.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	2000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate	2040	2850	3680	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling — Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

Anode cooling is accomplished by circulating water through the integral water jacket. The tabulation below lists the minimum water flow requirements for 25°C inlet water temperature.

PLATE DISSIPATION (Watts)	WATER FLOW (gpm)	PRESSURE DROP (psi)
1000	0.5	0.25
2000	1.5	1.25

Water pressure should never exceed 50 psi and outgoing water temperature must be limited to 70°C.

At ambient temperatures of 25°C, or less, when mounted in an EIMAC SK-800B socket, the 4CW2000A does not require base cooling. At higher temperatures, however separate base cooling may be required.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater — The rated heater voltage for the 4CW2000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation — The grid dissipation rating of the 4CW2000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it neccessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five milliamperes as read on a five-milliamperes meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CW2000A is 12 watt and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to

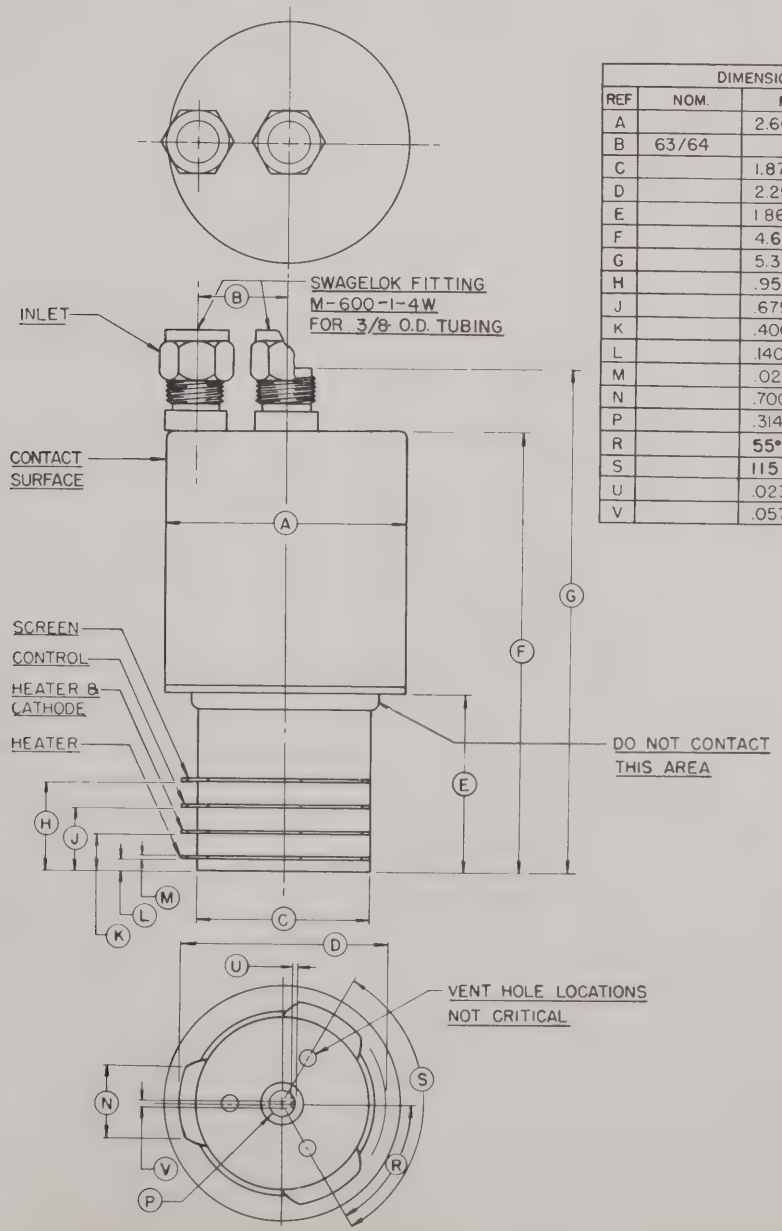
the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

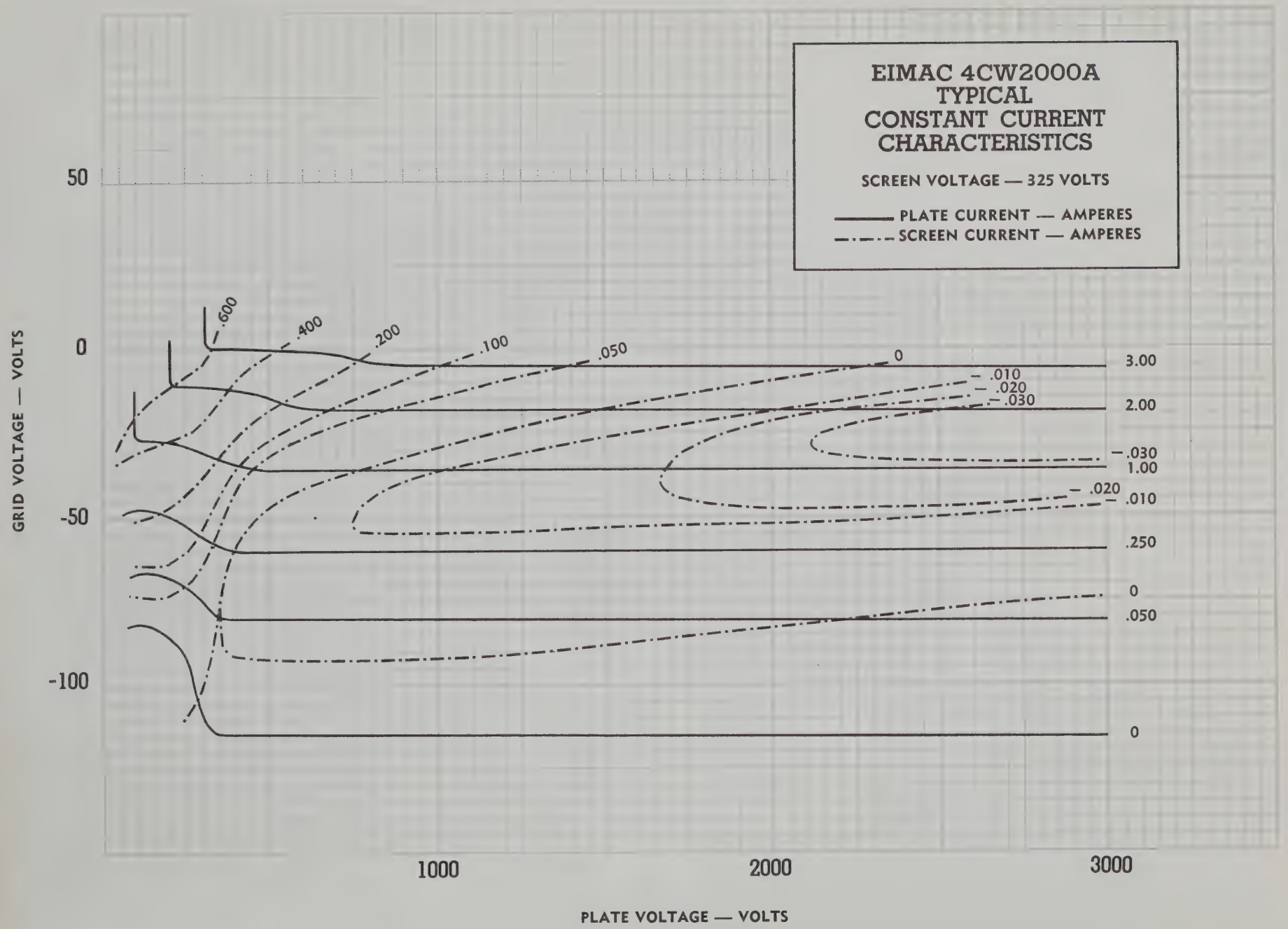
Plate Operation — The maximum rated plate dissipation power is 2000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

Voltage or Current Regulator — The 4CW-2000A is attractive for regulator service. As a voltage or current regulator the DC Plate Voltage rating is increased to 6000 volts. All other ratings remain the same.

Special Applications — If it is desired to operate this tube under conditions different from those given here, write to the Application Engineering Department, EIMAC Division of Varian San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF	NOM.	MIN.	MAX.
A		2.609	2.663
B	63/64		
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		1.866	2.002
F		4.677	4.817
G		5.347	5.535
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
U		.023	.043
V		.057 DIA.	.073 DIA.


EIMAC 4CW2000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
1.00
.250
.050

EIMAC
Division of Varian

4CX300Y

CERAMIC POWER TETRODE

The EIMAC 4CX300Y is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 400 watts. The 4CX300Y may be operated at maximum ratings to 110 MHz.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300Y especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage (See "Application")		6.0		volts
Current (E_f=6.0 volts)	3.0		3.85	amperes
Amplification Factor (Grid to Screen)	4.0		5.6	
Transconductance (I_b=200 ma.)		12,000		μmhos

Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Nom.	Max.	
Input	30		38	μμf
Output	3.9		5.0	μμf
Feedback			0.07	μμf
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input		18		μμf
Output	3.9		5.0	μμf
Feedback		0.01		μμf
Frequency for Maximum Ratings			110	MHz

MECHANICAL

Base	Special, breechblock terminal surfaces
Recommended Socket	EIMAC SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Maximum Over-All Dimensions:	
Height	2.5 inches
Diameter	1.65 inches
Net Weight	4 ounces
Shipping Weight (Approximate)	1 pound

(Revised 6-15-66) © 1962, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	400 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	8 WATTS
GRID DISSIPATION	1 WATT

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	—90	—90	—90 volts
DC Plate Current	0.38	0.4	0.4 amps
DC Screen Current*	31	26	26 mA
DC Grid Current*	32	33	33 mA
Peak RF Grid Voltage*	110	110	110 volts
Driving Power*	3.5	3.8	3.8 watts
Plate Input Power	380	600	800 watts
Plate Output Power	240	425	600 watts

*Approximate values

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	400 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	8 WATTS
GRID DISSIPATION	1 WATT

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	400	200	200 mA
Max-Signal DC Plate Current	800	790	750 mA
Max-Signal DC Screen Current	24	16	4 mA
Effective Load, Plate to Plate	2060	3000	5100 ohms
Peak AF Grid Input Voltage (per tube)*	55	65	60 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	340	800	890 watts

*Approximate values
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	400 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	8 WATTS
GRID DISSIPATION	1 WATT

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	200	100	100 mA
DC Plate Current	280	210	205 mA
DC Screen Current*	—5	—5	—5 mA
Peak RF Grid Voltage*	28	33	30 volts
Plate Output Power	52	110	115 watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	400 MA
PLATE DISSIPATION	400 WATTS
SCREEN DISSIPATION	8 WATTS
GRID DISSIPATION	1 WATT

TYPICAL OPERATION (Peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	200	100	100 mA
Peak RF Grid Voltage*	55	65	60 volts
DC Plate Current	400	395	375 mA
DC Screen Current*	12	8	2 mA
Plate Input Power	400	590	750 watts
Plate Output Power	170	400	415 watts
Two-Tone Average DC Plate Current			
Two-Tone Average DC Screen Current			

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	300 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	8 WATTS
GRID DISSIPATION	1 WATT

TYPICAL OPERATION

DC Plate Voltage	1000	1500 volts
DC Screen Voltage	250	250 volts
DC Grid Voltage	—130	—130 volts
DC Plate Current	285	300 mA
DC Screen Current*	24	18 mA
DC Grid Current*	17	17 mA
Peak RF Grid Input Voltage*	148	148 volts
Driving Power*	1.7	1.7 watts
Plate Input Power	285	500 watts
Plate Output Power	165	300 watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance has been made for circuit losses. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variation in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting — The 4CX300Y may be operated in any position. Recommended sockets for the 4CX300Y are the EIMAC Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater contact grounded). Both sockets provide connections to all electrodes except the anode and each incorporates a screen by-pass capacitor of approximately 1100 $\mu\mu$f. The SK-606 chimney is recommended for use with the SK-700 and SK-710 sockets.

Other sockets suitable for use with the 4CX300Y include the SK-740, SK-760, and SK-770. These sockets do not incorporate screen by-pass capacitors. The SK-760 and SK-770 incorporate integral air chimneys. Screen contacts are connected to the mounting flange in the SK-770 and are, therefore, grounded when the socket is installed in the usual manner.

Cooling — The maximum rated ceramic-to-metal seal temperature for the 4CX300Y is 250°C. Adequate forced-air cooling must be provided to assure that this maximum temperature rating is not exceeded. Air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below.

Plate Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
100	2.2	0.065	3.2	0.095
150	3.4	0.14	4.9	0.21
200	4.6	0.26	6.7	0.37
250	5.9	0.40	8.6	0.58
300	7.2	0.58	10.5	0.85
350	8.7	0.82	12.7	1.2
400	10.3	1.12	15.0	1.6

A new, more efficient cooling fin design is incorporated in the 4CX300Y which results in lower air-flow requirements. This is reflected in the table above (which assumes the use of an EIMAC SK-700 or SK-710 socket and SK-606 chimney).

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300Y is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

ELECTRICAL

Heater Operation — The rated heater voltage for the 4CX300Y is 6.0 volts.

The heater voltage must be maintained within ±5% of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation — The 4CX300Y employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation — The 4CX300Y control grid has a maximum dissipation rating of 1.0 watt, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

In class-A and class AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation — The maximum rated screen dissipation for the 4CX300Y is 8 watts. The maximum rated dc screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB_1 or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated dc values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

A screen by-pass capacitor of approximately 1100 $\mu\mu$f is incorporated in the body of the EIMAC SK-700 and SK-710 Air-System Sockets and is adequate for normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require that additional capacitance be connected externally. In the latter case, the screen by-pass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300Y is above the useful high-frequency limit for the tube when either of the sockets with integral screen by-pass capacitors is used.

Plate Operation—The 4CX300Y has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used

when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300Y is 400 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB_1 amplifier applications. When the 4CX300Y is used in plate-modulated amplifier applications, the plate-dissipation rating is 250 watts under carrier conditions, rising to 400 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

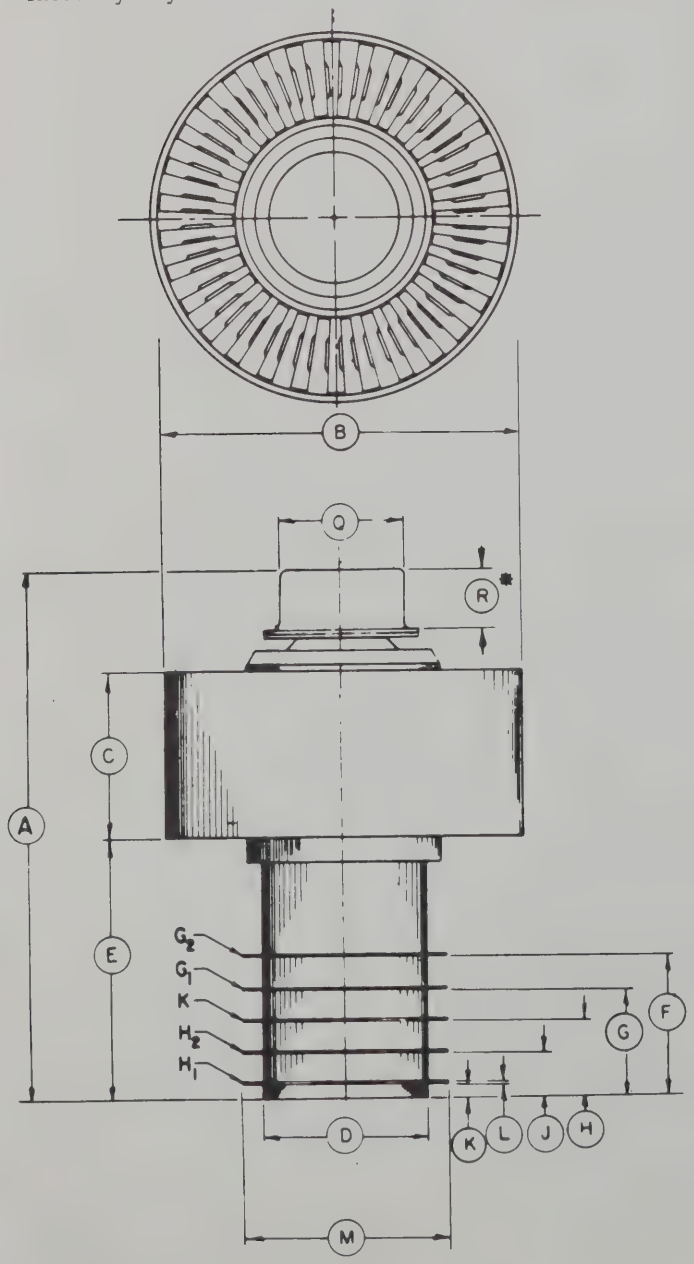
The maximum rated plate voltage for class-AB_1 operation is 2000 volts. In class-C telegraphy and plate-modulated service the maximum rated plate voltage is 2000 and 1500 volts respectively.

Modulation — The 4CX300Y can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

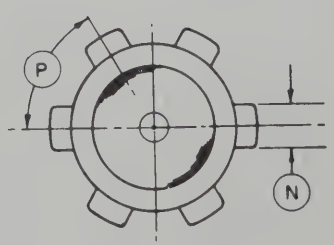
Plate modulation can be applied to the 4CX300Y when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation" above.

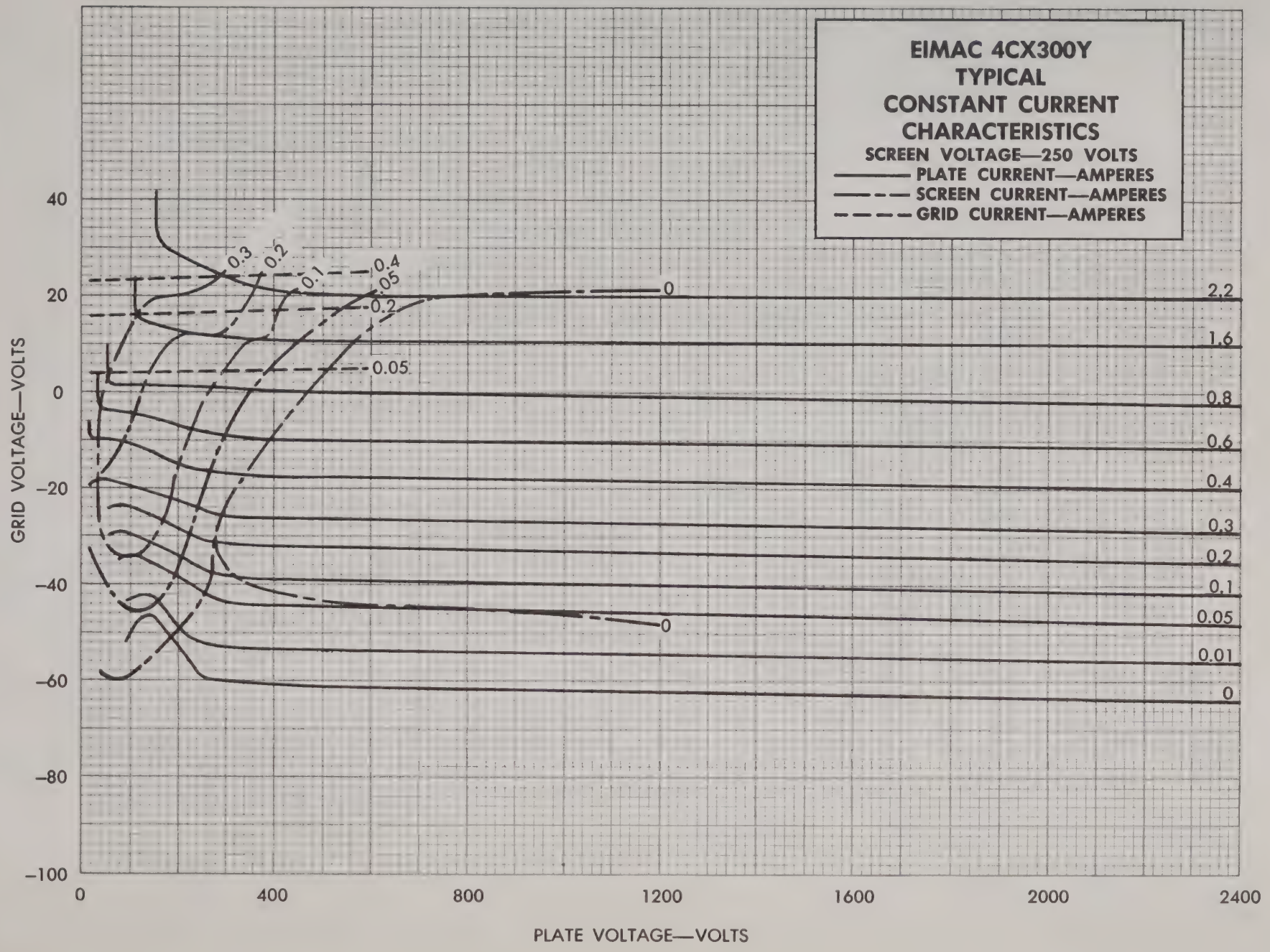
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

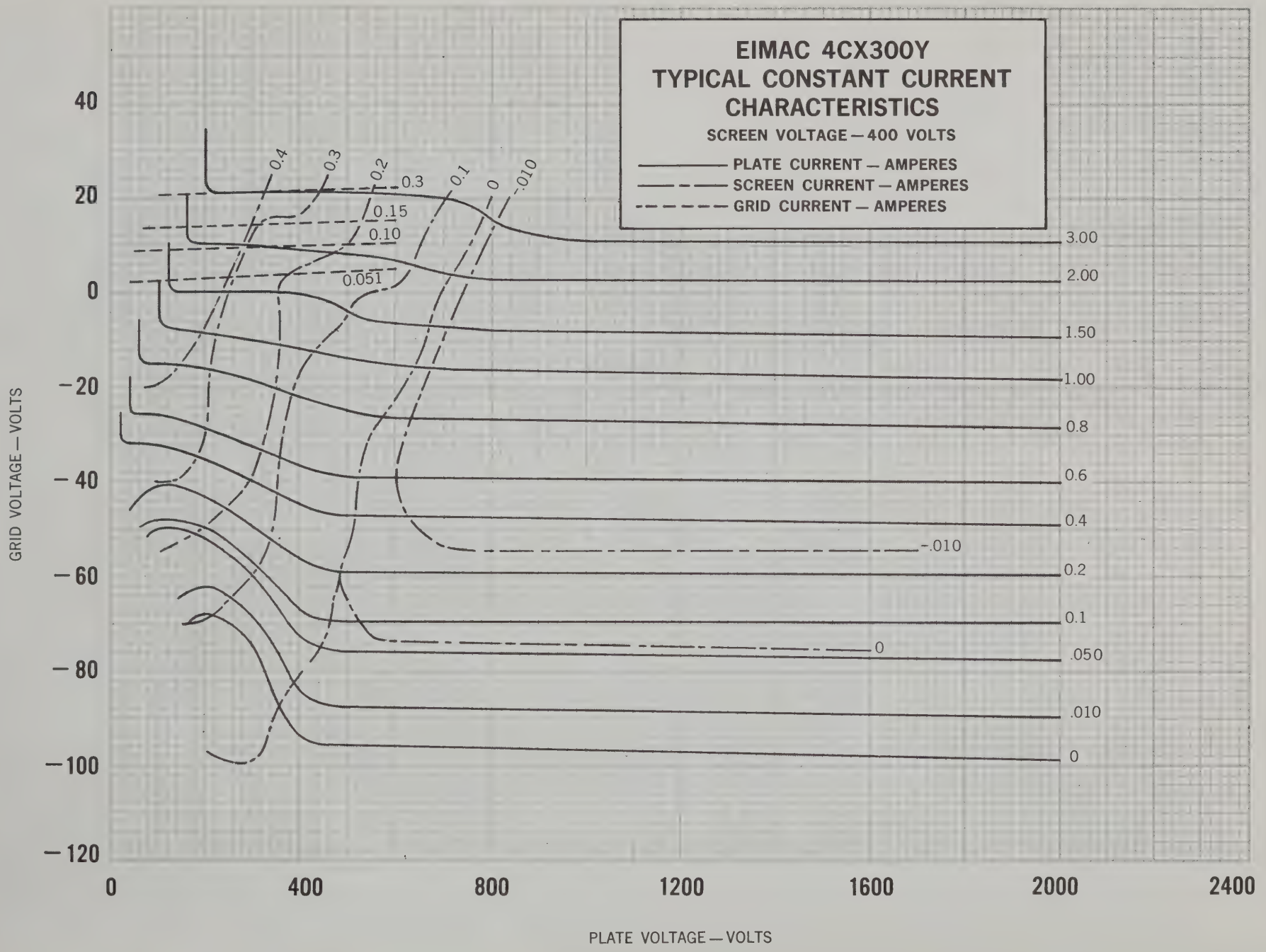


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		2.300	2.500
B		1.610	1.640
C		.710	.790
D		.740	.770
E		1.133	1.195
F		.602	.642
G		.470	.500
H		.329	.359
J		.193	.213
K		.050	.072
L		.010	.020
M		.936	.956
N		.170	.185
P	60°		
Q		.559	.573
R		.240	.280



*CONTACT SURFACE


EIMAC 4CX300Y
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE—250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
2400
PLATE VOLTAGE—VOLTS
0.3
0.2
0.1
0.4
.05
0.2
0.05
0
0
2.2
1.6
0.8
0.6
0.4
0.3
0.2
0.1
0.05
0.01
0


EIMAC 4CX300Y
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100
−120
0
400
800
1200
1600
2000
2400
0.4
0.3
0.2
0.3
0.1
0
-.010
0.15
0.10
0.051
3.00
2.00
1.50
1.00
0.8
0.6
0.4
-.010
0.2
0.1
0
.050
.010
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8168
4CX1000A

CERAMIC POWER TETRODE

The EIMAC 8168/4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1630 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3260 watts of audio power.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		μmhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	μμf
Output	11		13	μμf
Feedback			0.022	μμf

	Min.	Nom.	Max.	
Direct Interelectrode Capacitances, Grounded Grid and Screen:*				
Input	32.5		38.0	μμf
Output	11		13	μμf
Feedback			0.004	μμf
Frequency for Maximum Ratings			110	MHz

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Any
Maximum Over-all Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB or B
(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	250	250	250	mA
Single-Tone DC Plate Current*	890	885	875	mA
Two-Tone Average DC Plate Current	645	650	635	mA
Zero-Signal DC Screen Current*	8	6	5	mA
Single-Tone DC Screen Current*	35	35	35	mA
Two-Tone Average DC Screen Current*	10	8	8	mA
Plate Output Power	930	1300	1630	watts

*Approximate values.
[1]Adjust grid bias to obtain zero-signal plate current.

(Revised 6-15-66) © 1963, 1966 Varian

Printed in U.S.A.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate	2040	2850	3680	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling — Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.
At higher altitudes and at VHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

The 4CX1000A is tested for vibration (noise) from 10 Hz to 500 Hz. Vibration level is 10 G units peak 28 Hz to 500 Hz. Below 28 Hz vibration double amplitude is .25 inch.

The 4CX1000A is tested for shock, 50 G, 11 ms, three axes, after which the tube must be within specification for grid bias voltage and gas current.

ELECTRICAL

Heater — The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation — The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five-milliamperes as read on a five-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and

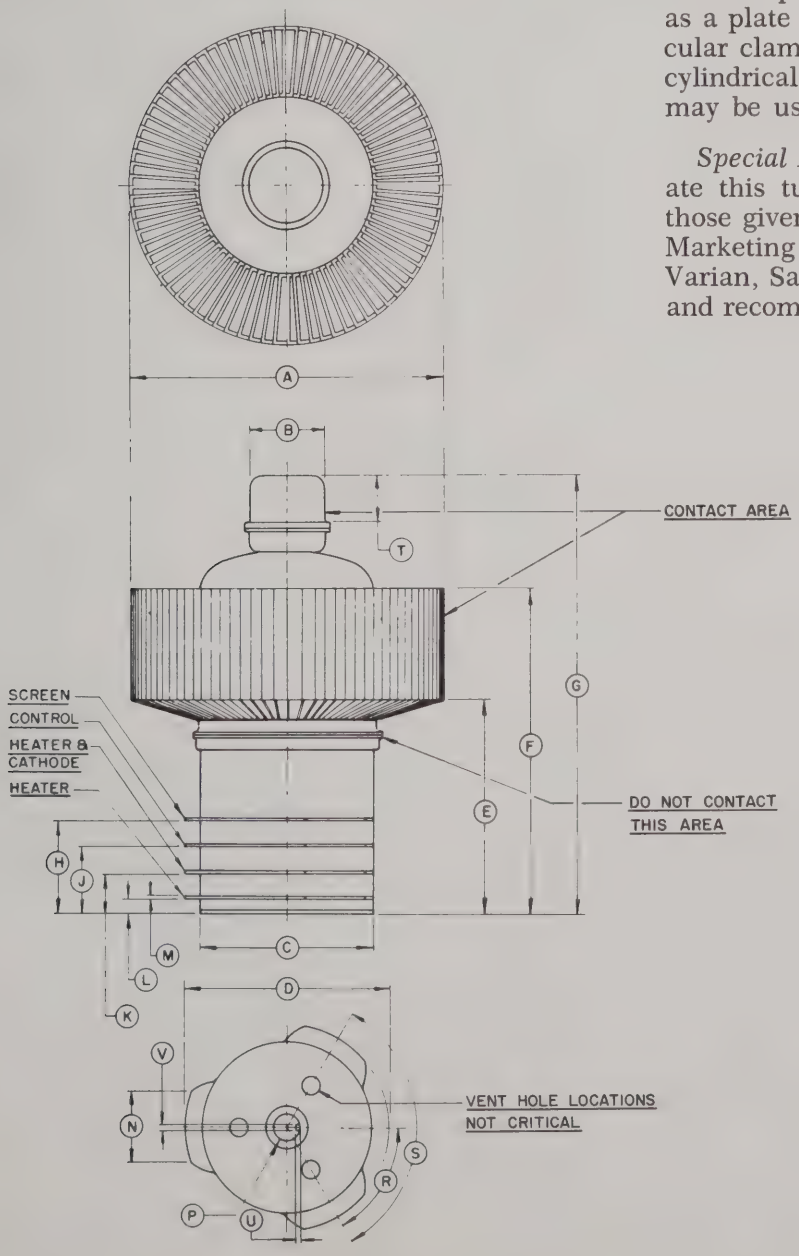
the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

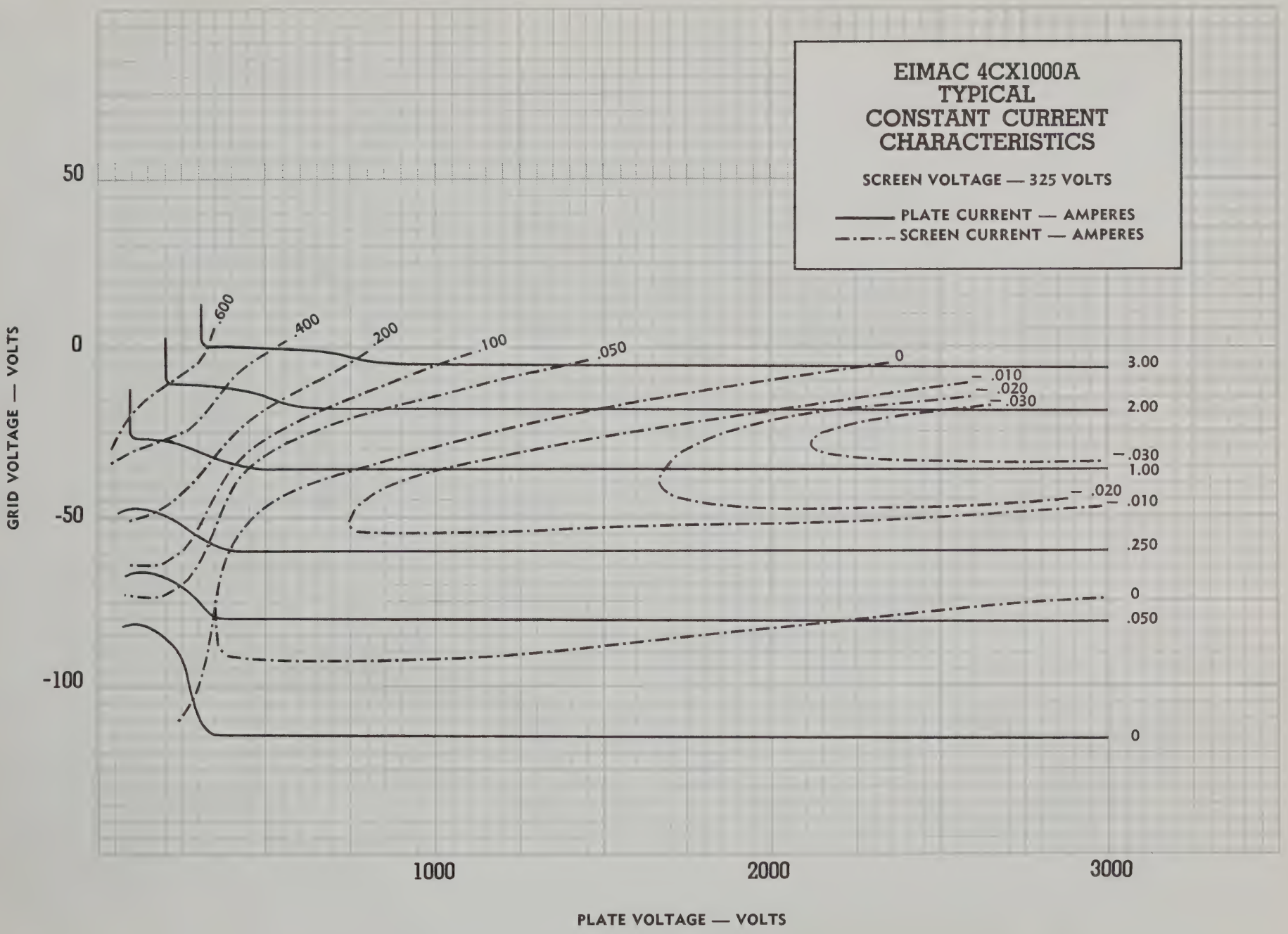
Plate Operation — The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, EIMAC Division of Varian, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.


EIMAC 4CX1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0
1000
2000
3000
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian

8281
4CX15,000A

RADIAL-BEAM POWER TETRODE

The EIMAC 8281/4CX15,000A is a ceramic-metal power tetrode intended for use as a Class-C amplifier in radio-frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 8281/4CX15,000A at full ratings up to 110 megahertz.

The 8281/4CX15,000A is also recommended for Class-AB audio-frequency and radio-frequency linear power amplifier service.



GENERAL CHARACTERISTICS

	Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten				
Voltage		6.3		volts
Current	152		168	amps
Amplification Factor (Grid-Screen) (average)	4.5			
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	148.5		161.5	μμf
Output	22.0		27.0	μμf
Feedback			2.0	μμf
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input	60.0		70.0	μμf
Output	23.0		28.0	μμf
Feedback			0.3	μμf
Base			Special, concentric	
Maximum Seal Temperature			250°C	
Maximum Anode Core Temperature			250°C	
Recommended Socket			EIMAC SK-300A	
Recommended Air Chimney			EIMAC SK-316	
Operating Position	Axis vertical, base up or down			
Maximum Dimensions:				
Height			9.44	inches
Diameter			7.58	inches
Cooling			Forced air	
Net Weight			12.8	pounds
Shipping Weight (Approximate)			24	pounds

(Revised 8-15-66) © 1962, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	5.0 AMPS
PLATE DISSIPATION*	15,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

TYPICAL OPERATION

DC Plate Voltage	7,500	10,000 volts
DC Screen Voltage	750	750 volts
DC Grid Voltage	—510	—550 volts
DC Plate Current	4.65	4.55 amps
DC Screen Current	.595	.545 amp
DC Grid Current	.300	.275 amp
Peak RF Grid Voltage	730	790 volts
Driving Power	220	220 watts
Plate Dissipation	8,100	9,000 watts
Plate Output Power	26,700	36,500 watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	8,000 VOLTS
DC SCREEN VOLTAGE	1,500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	10,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Corresponds to 15,000 watts at 100% sinewave modulation.

TYPICAL OPERATION

DC Plate Voltage	6,000	8,000 volts
DC Screen Voltage	750	750 volts
Peak AF Screen Voltage (For 100% modulation)	740	710 volts
DC Grid Voltage	—600	—640 volts
DC Plate Current	3.75	3.65 amps
DC Screen Current	.450	.430 amp
DC Grid Current	.185	.180 amp
Peak RF Grid Voltage	800	840 volts
Grid Driving Power	150	150 watts
Plate Dissipation	5,100	5,800 watts
Plate Output Power	17,400	23,500 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
PLATE DISSIPATION	15,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Per Tube
**Approximate Values

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	7,500	10,000 volts
DC Screen Voltage	1,500	1,500 volts
DC Grid Voltage	—350	—370 volts
Max-Signal Plate Current	8.8	8.5 amps
Zero-Signal Plate Current*	1.0	1.0 amp
Max-Signal Screen Current**	.340	.300 amp
Zero-Signal Screen Current	0	0 amps
Peak AF Driving Voltage*	330	340 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	1,730	2,520 ohms
Max-Signal Plate Dissipation*	12,200	14,000 watts
Max-Signal Plate Output Power	41,600	57,000 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
PLATE DISSIPATION	15,000 WATTS
SCREEN DISSIPATION	450 WATTS
GRID DISSIPATION	200 WATTS

*Approximate Values

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions

DC Plate Voltage	7,500	10,000 volts
DC Screen Voltage	1,500	1,500 volts
DC Grid Voltage	—350	—370 volts
Max-Signal Plate Current	4.4	4.25 amps
Zero-Signal Plate Current	1.0	1.0 amp
Max-Signal Screen Current*	.170	.150 amp
Peak RF Grid Voltage*	330	340 volts
Driving Power	0	0 watts
Plate Dissipation	12,200	14,000 watts
Plate Output Power	20,800	28,500 watts
Resonant Load Impedence	865	1,260 ohms

NOTE: "TYPICAL OPERATION" data are obtainable by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variation in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4CX15,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket — A new, more efficient EIMAC Air-System Socket Type SK-300A has been designed especially for the concentric base terminals of the 4CX15,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-316, into the anode cooling fins.

Cooling — The maximum temperature rating for the external surfaces of the 4CX15,000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

Plate Dissipation* (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
7,500	179	0.8	283	1.27
12,000	358	2.4	566	3.8
15,000	513	4.2	812	6.64

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation — The rated filament voltage for the 4CX15,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Electrode Dissipation Ratings — The maximum dissipation ratings for the 4CX15,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

Control-Grid Operation — The 4CX15,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation—The power dissipated by the screen of the 4CX15,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

Plate Dissipation — The plate-dissipation rating for the 4CX15,000A is 15,000 watts.

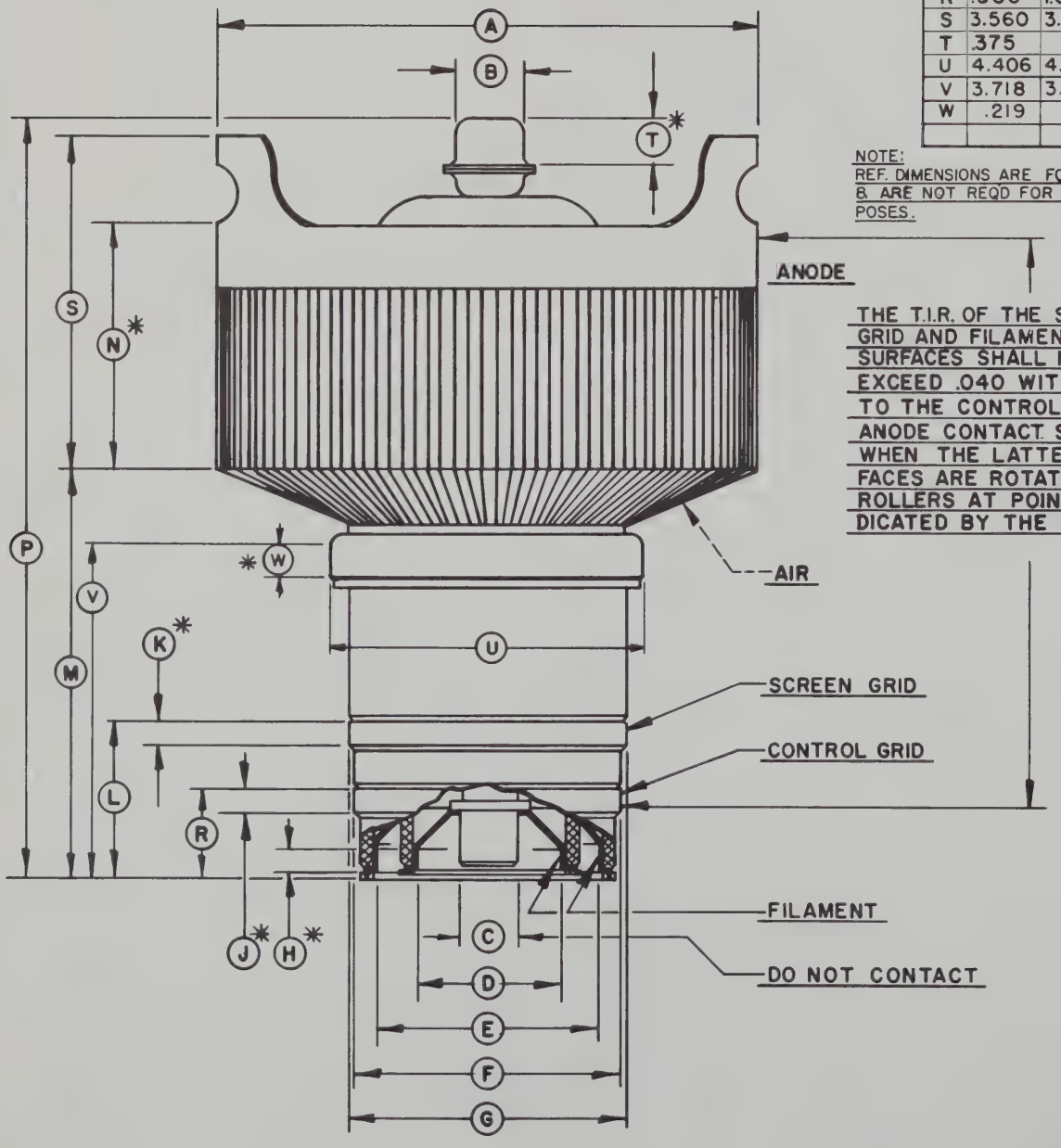
When the 4CX15,000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000 watt maximum plate dissipation rating will be exceeded.

Special Applications — If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	7.460	7.580	
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
G	3.980	4.020	
H	.188		
J	.188		
K	.188		
L	1.764	1.826	
M	4.659	4.783	
N	2.412	2.788	
P	9.000	9.375	
R	.986	1.050	
S	3.560	3.684	
T	.375		
U	4.406	4.468	
V	3.718	3.781	
W	.219		

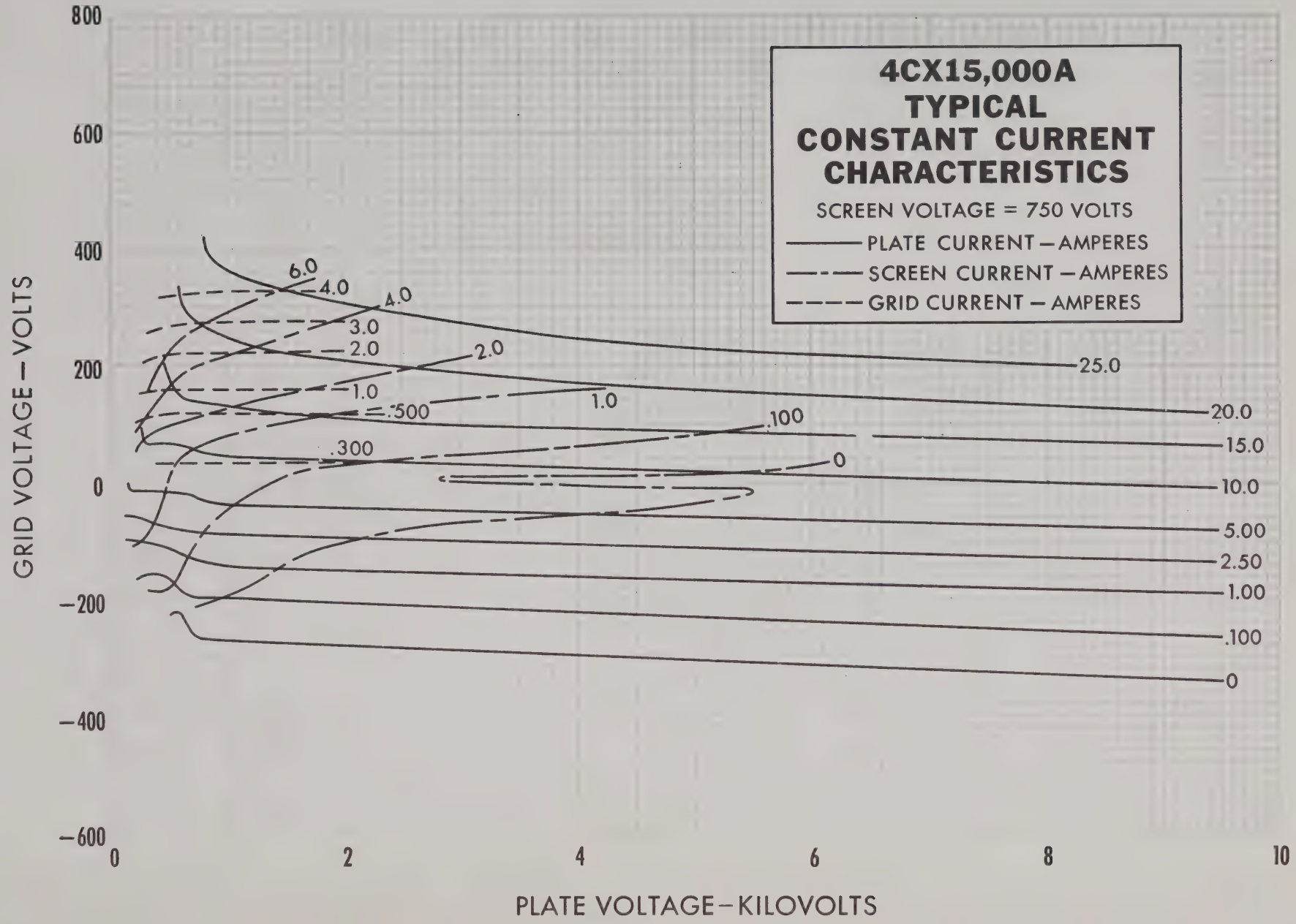
NOTE:
REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQD FOR INSP. PURPOSES.

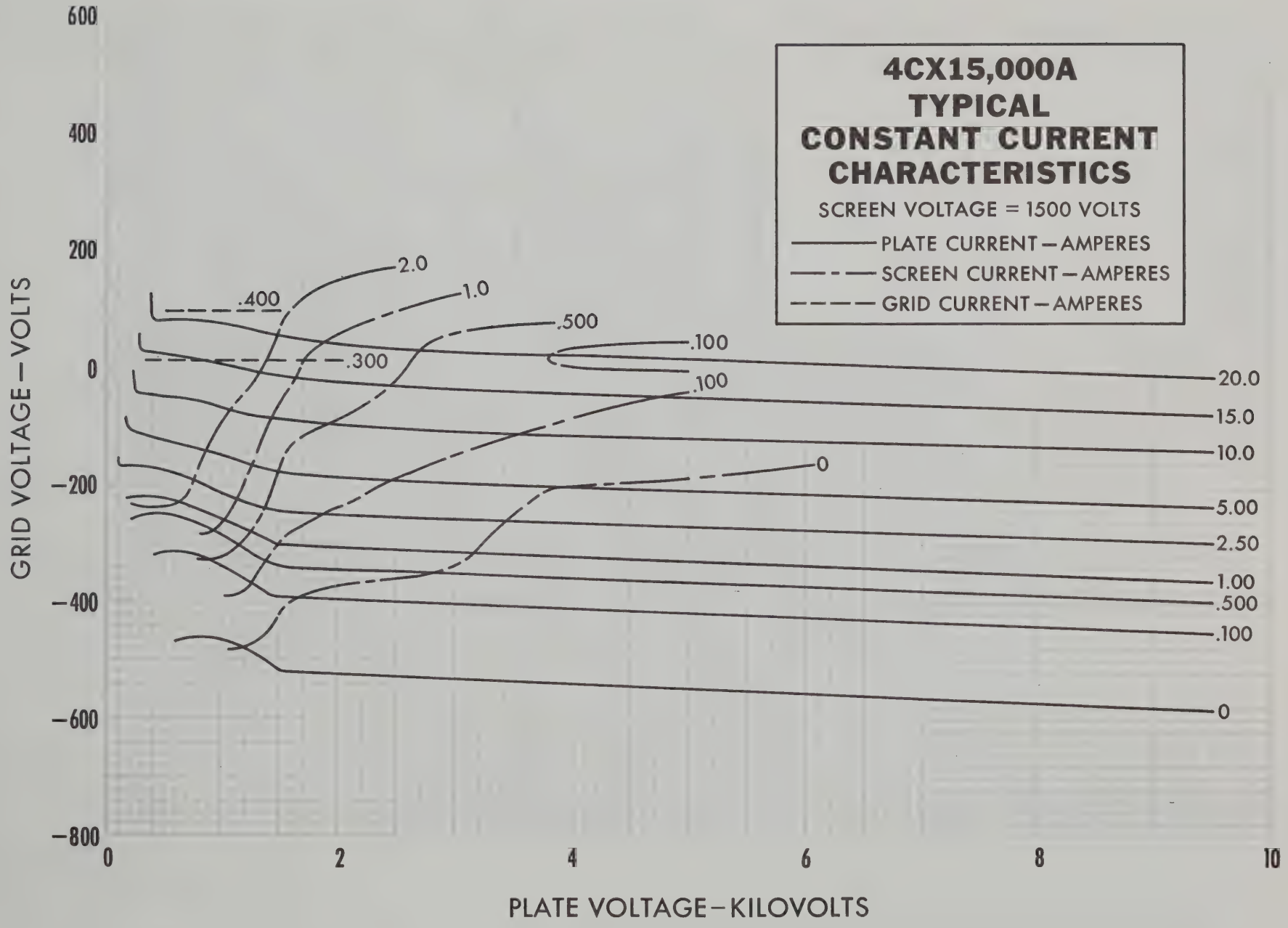


THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID AND ANODE CONTACT SURFACE WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT POINTS INDICATED BY THE ARROWS

* CONTACT SURFACE

4CX 15,000 A


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
800
600
400
200
0
−200
−400
−600
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
6.0
4.0
4.0
3.0
2.0
2.0
1.0
1.0
.500
.100
.300
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
600
400
200
0
−200
−400
−600
−800
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
2.0
1.0
.500
.100
.400
.300
.100
0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0

EIMAC
Division of Varian

8172
4X150G

RADIAL-BEAM POWER TETRODE

The EIMAC 8172/4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-voltage. The combination of a high ratio of transconductance to capacitance and a plate dissipation capability of 250 watts makes the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megahertz, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megahertz an output power of 50 watts per tube is obtained with a power-gain of five.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-heater Potential			150	volts
Heater: Voltage		2.5		volts
Current	6.2		7.3	amperes
Amplification Factor (Grid-to-Screen)		5		

Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	25.0	29.0	μμf
Output	4.0	4.9	μμf
Feedback		0.05	μμf

Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.	
Input	14.5	19	μμf
Output	4.0	4.9	μμf
Feedback		0.01	μμf

Frequency for Maximum Ratings (CW)	500 MHz
(pulsed)	1500 MHz

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175°C
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Maximum Dimensions:	
Height	2.75 inches
Diameter	1.635 inches
Cooling	Forced Air
Net Weight	6 ounces
Shipping Weight (Approximate)	1.6 pounds

(Revised 6-15-66) © 1959, 1966 Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	600	750	1000	1250	1250	volts
DC Screen Voltage	250	250	250	250	250	volts
DC Grid Voltage	—75	—80	—80	—90	—80	volts
DC Plate Current	200	200	200	200	200	mA
DC Screen Current*	37	37	30	20	7	mA†
DC Grid Current*	10	10	10	10	10	mA†
Peak RF Grid Voltage*	90	95	95	105	—	volts
Driving Power*	0.7	0.7	0.7	0.8	10	watts†
Plate Input Power	120	150	200	250	250	watts
Plate Output Power	85	110	150	195	140	watts†

*Approximate values.
†Measured values for a typical cavity amplifier circuit.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	—250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	600	800	1000	volts
DC Screen Voltage	250	250	250	volts
DC Grid Voltage	—95	—100	—105	volts
DC Plate Current	200	200	200	mA
DC Screen Current*	35	25	20	mA
DC Grid Current*	8	10	15	mA
Peak RF Grid Input Voltage*	120	120	125	volts
Driving Power*	1	1.5	2	watts
Plate Input Power	40	60	60	watts
Plate Output Power	120	160	200	watts

*Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	250 VOLTS
DC PLATE CURRENT (Average)	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION
(Frequencies up to 216 MHz, 5-MHz bandwidth)

DC Plate Voltage	750	1000	1250	volts
DC Screen Voltage	300	300	300	volts
DC Grid Voltage	—60	—65	—70	volts
During Sync-Pulse Peak:				
DC Plate Current	335	330	305	mA
DC Screen Current	50	45	45	mA
DC Grid Current	15	20	25	mA
Peak RF Grid Voltage	85	95	100	volts
RF Driving Power (approx.)	7	8	9	watts
Useful Power Output	135	200	250	watts
Black Level:				
DC Plate Current	245	240	230	mA
DC Screen Current	20	15	10	mA
DC Grid Current	4	4	4	mA
Peak RF Grid Voltage (approx.)	65	70	75	volts
RF Driver Power (approx.)	4.25	4.7	5.5	watts
Plate Power Input	185	240	290	watts
Useful Power Output	75	110	140	watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 VOLTS
PULSED SCREEN VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	—500 VOLTS
PULSE DURATION	5 USEC
PULSED CATHODE CURRENT	7 AMPS
AVERAGE POWER INPUT	250 WATTS
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL PULSE OPERATION
Single tube oscillator, 1200-MHz

Pulsed Plate Voltage	5	7	kV
Pulsed Plate Current	4.0	6.0	amps
Pulsed Screen Voltage	800	1200	volts
Pulsed Screen Current	0.3	0.4	amps
DC Grid Voltage	—200	—250	volts
Pulsed Grid Current	0.5	0.6	amps
Pulse Duration	4	5	μsec
Pulse Repetition Rate	2500	1000	pps
Peak Power Output	7	17	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz peak-envelope conditions except where noted)

DC Plate Voltage	1000	1250	volts
DC Screen Voltage	350	350	volts
DC Grid Voltage*	—55	—55	volts
Zero-Signal DC Plate Current	100	100	mA
Peak RF Grid Voltage**	50	50	volts
DC Plate Current	250	250	mA
DC Screen Current**	10	9	mA
Plate Input Power	250	310	watts
Plate Output Power	120	170	watts
Two-Tone Average DC Plate Current	190	190	mA
Two-Tone Average DC Screen Current**	2	—1	mA

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X150G may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling — The 4X150G requires sufficient forced air to keep the glass-to-metal seals below 175°C and the ceramic-metal seals and anode core below 250°C. The air flow must be started when power is applied to the heater and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 175°C and the center heater terminal below 250°C.

The air requirements stated above are based on operation at sea level an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow.

Temperature of the external parts of a tube may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

ELECTRICAL

Heater — The rated heater voltage for the 4X150G is 2.5 volts, and should be maintained at this value plus or minus five percent. At frequencies above 400 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 1000 MHz:

Frequency	Filament
1001 to 1500 MHz	2.5 volts
up to 400 MHz	2.2 volts
401 to 1000 MHz	2.0 volts

Cathode — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation — The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected

between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150G.

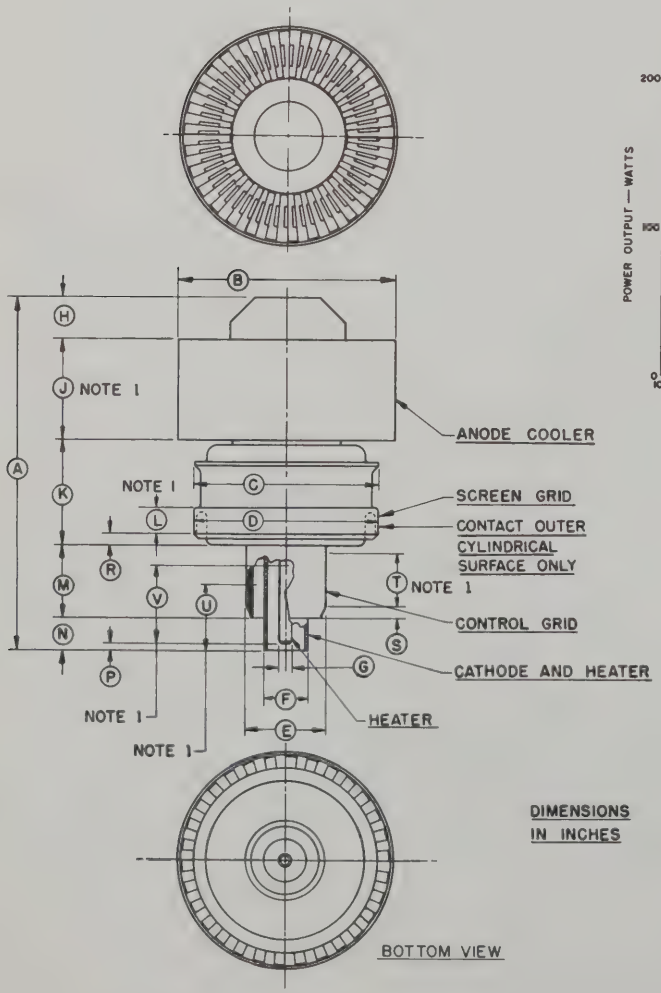
Plate Operation — The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

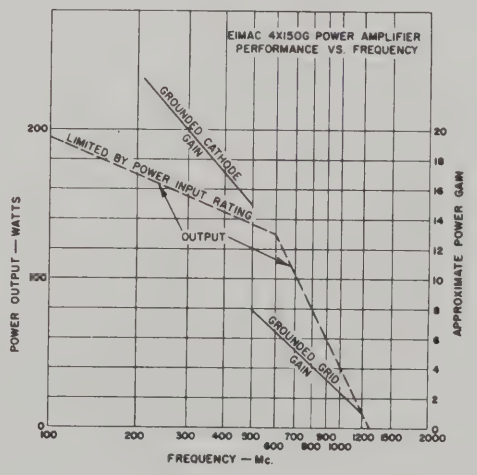
UHF Operation — The 4X150G is suitable use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

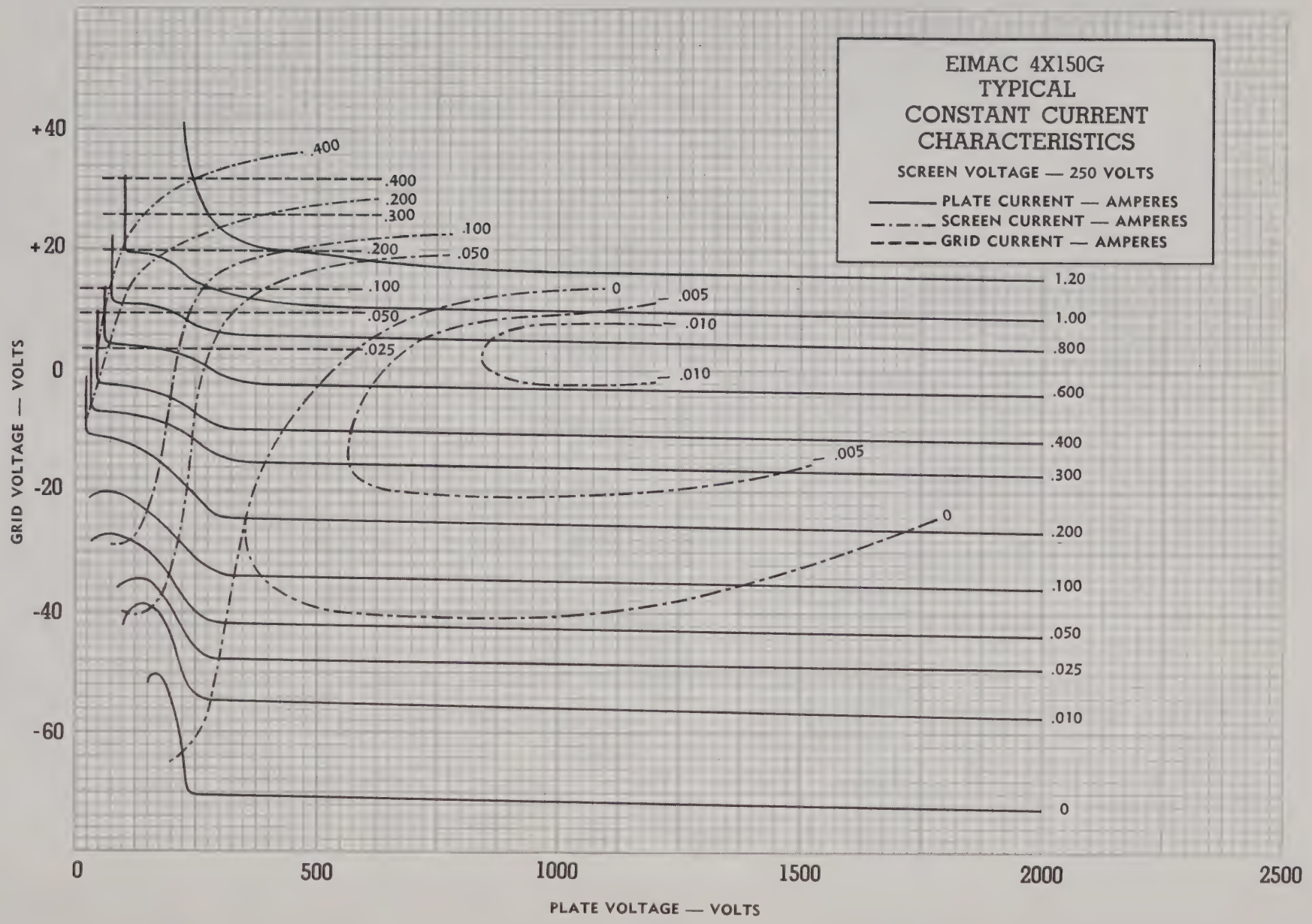
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, San Carlos, California, for information and recommendations.

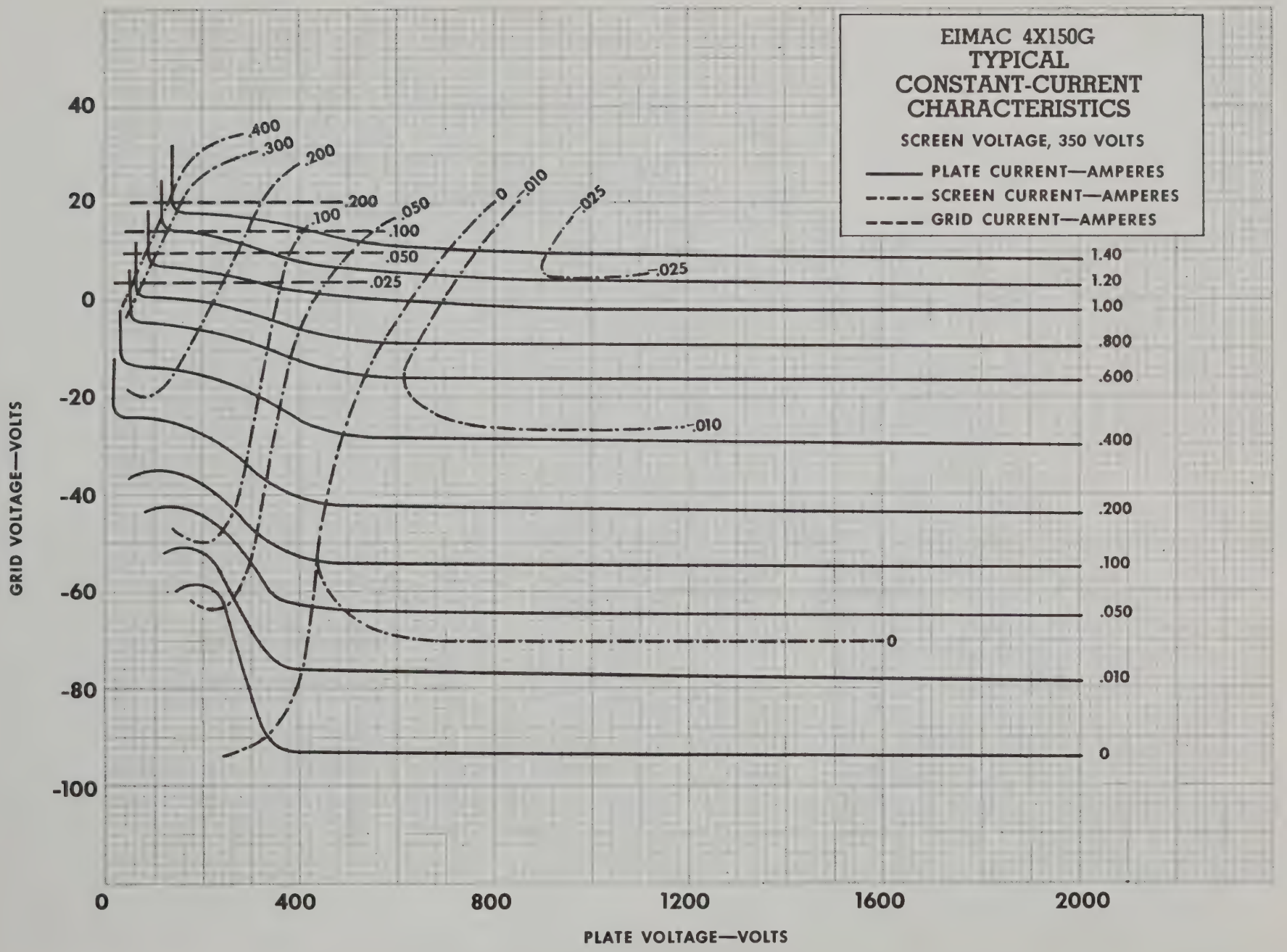


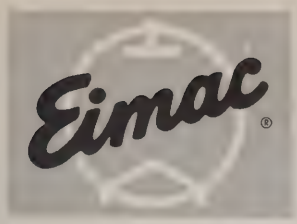


DIMENSION			
REF	NOMINAL	MINIMUM	MAXIMUM
A			2 3/4
B		1.615	1.635
C			1.406
D		1.417	1.433
E		.587	.597
F		.317	.327
G		.088	.098
H			5/16
J		23/32	25/32
K		3/4	13/16
L		3/16	
M		.500	.578
N		15/64	17/64
P		1/32	1/16
R	3/32		
S	1/8		
T		11/32	
U		13/32	
V		15/32	

NOTE 1. LENGTH AVAILABLE FOR CONTACT.


EIMAC 4X150G
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
+40
+20
0
-20
-40
-60
PLATE VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.200
.300
.100
.050
.025
.010
.005
0
.005
0


EIMAC 4X150G
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
.400
.300
.200
.100
.050
.025
0
.010
.025
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TABLE OF CONTENTS
VOL. I

GENERAL — Date

Eimac Field Representatives ..... ———
Tube Type Numbering System 4-3-58
Distributors 5-15-64
Eimac and EIA Tube Number Cross Reference Sheet ..... February '64
Power Frequency Chart for Power Grid .. ———

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C 1-22-60
2-25A 7-1-52
2-50A 7-1-52
2-150D 7-1-52
2-240A 10-21-59
2-450A 11-3-59
2-2000A 7-1-52
2X3000F 6-1-63
250R 8-1-64
253 7-1-52
575A & 673 3-16-64
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020(100R) 2-1-52
4PR60B/8252 2-15-62
4PR65A/8187 2-15-63
4PR125A/8247 7-15-62
4PR250C/8248 12-1-63
4PR400A/8188 ..... ———
4PR1000A/8189 3-20-62
6C21 4-1-54
KY21A 1-2-63
RX21A 1-2-63

TRIODES

2C39A 10-25-62
2C39WA 2-7-58
3-400Z/8163 6-1-62
3-1000Z/8164 4-9-64
3C24 11-1-51
3CPN10A5/7815 1-1-63
3CPX100A5/7815R 1-1-63
3CV30,000A3 10-1-63
3CW20,000A1 1-1-63
3CW20,000A3 5-1-63
3CW20,000A7 1-1-63
3CW25,000A3 11-1-63
3CX100A5/7289 & 3CX100F5/8250 5-1-62
3CX1000A7/8283 3-1-63
3CX25000F3 9-1-64
3CX10,000A1/8158 8-14-64
3CX10,000A3/8159 8-15-64
3CX10,000A7/8160 11-1-63

TRIODES (Continued) — Effective Date

3W5000A1/8240 2-18-63
3W5000A3/8242 6-1-64
3W5000F1/8241 2-18-63
3W5000F3/8243 10-20-61
3X2500A3/8161 11-20-61
3X2500F3/8251 6-30-64
3X3000A1/8238 2-18-63
3X3000A7 5-20-63
3X3000F1/8239 2-18-63
3X3000F7/8162 5-5-61
25T 2-1-51
35T 12-30-57
*35TG 5-1-62
75TH 1-2-52
75TL 1-2-52
100TH 4-1-49
100TL ..... ———
*152TH 11-25-52
*152TL 1-1-44
250TH 5-1-53
250TL 1-1-61
304TH 4-10-53
304TL 8-15-64
450TH 8-1-50
450TL 10-1-49
592/3-200A3 7-1-54
750TL 12-11-57
1000T 4-22-58
1500T 3-18-59
2000T 10-15-50
6696A 10-15-64
6697A 10-15-64
7211 9-1-64
7480 10-15-64

TETRODES – PENTODES

4-65A/8165 5-1-62
4-125A/4D21 6-1-60
4-250A/5D22 5-1-62
4-400A/8438 2-15-63
4-1000A/8166 7-1-62
4CN15A 1-1-63
4CS100L 4-20-64
4CV8000A 11-8-62
4CV20,000A 11-8-62
4CV35,000A 12-3-62
4CV100,000C/8351 6-1-63
4CW2000A 11-19-63
4CW10,000A 4-15-63
4CW50,000C/8350 10-10-62
4CX125C,F 1-1-63
4CX250B/7203 & 4CX250F/7204 7-15-62
4CX250K/8245 & 4CX250M/8246 1-28-63

TETRODES–PENTODES (Continued) — Effective Date

4CX250R 6-16-61
4CX300A/8167 12-1-63
4CX300Y 11-1-63
4CX350A/8321 & 4CX350F/8322 10-12-62
4CX600A 5-7-63
4CX1000A/8168 11-4-63
4CX1000K/8352 1-1-64
4CX3000A/8169 3-1-63
4CX5000A/8170 10-1-64
4CX5000R/8170W 1-1-63
4CX10,000D/8171 1-20-62
4CX15,000A/8281 10-10-62
4CX35,000C/8349 11-1-63
4W300B 6-16-60
4W20,000A/8173 4-15-64
4X150A & 4X150D 6-15-60
4X150G/8172 8-15-63
4X150R/8296 & 4X150S/8297 5-15-62
4X500A 1-1-64
4E27A/5-125B 8-15-52

OTHER PRODUCTS

VS-2, 4, 5, & 6 12-1-63
100 IG Ionization Gauge 6-15-53
Preformed Contact Finger Stock 1-15-62
HR Heat Dissipating Connectors 12-12-57
CS-8301 Laser Tube Assembly 10-5-64
SK-300 1-1-63
SK-306, SK-316 5-21-63
SK-400 4-1-56
SK-406, SK-416 5-17-63
SK-410 11-15-62
SK-500 3-1-56
SK-506, SK-516 8-15-64
SK-510 5-4-63
SK-600 3-31-61
SK-606, SK-626, SK-636B 5-24-63
SK-610 3-31-61
SK-620, SK-620A 1-15-63
SK-630, SK-630A 1-18-63
SK-640 3-31-61
SK-650 and SK-655 3-31-61
SK-700, SK-710, SK-606 1-20-58
SK-711A 5-9-63
SK-740 5-9-63
SK-760, SK-770 5-9-63
SK-800B, SK-806 4-9-64
SK-810, SK-806 4-9-64
SK-860, SK-870 5-9-63
SK-890, SK-806 4-9-64
SK-900, SK-906 6-1-60
SK-1300 5-9-63
SK-1306, SK-1406 5-17-63
SK-1400A, SK-1470A 5-9-63

*Not recommended for New Equipment Design.

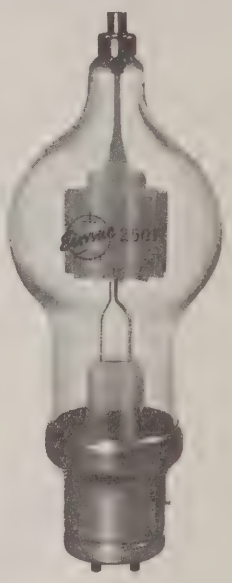
250R

HIGH-VACUUM RECTIFIER

The Eimac 250R is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 250R has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 60,000 volts. Cooling is by convection and radiation.

A single 250R will deliver 160 milliamperes at 24,000 volts to a capacitor-input filter with 21,000 volts single-phase supply. Four 250R's in a bridge circuit will deliver 500 milliamperes at 38,000 volts to a choke-input filter with 42,000 volts single-phase supply.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	10.5 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.82 inches
Net Weight	10 ounces
Shipping Weight (approx.)	3 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	60,000 MAX. VOLTS
PLATE DISSIPATION	150 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 250R must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 250R is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

(Effective 8-1-64) Copyright 1952 by Eitel-McCullough, Inc.

APPLICATION (Continued)

225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 250R reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 250R begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 60,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 250R when used as a power-supply rectifier.

250R MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	21,000	24,000	160	.....	.....
Single-Phase, Full-Wave	21,000[1]	24,000	320	19,000	500
Single-Phase, Bridge	42,000	48,000	320	38,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 250R is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 250R is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_l in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 250R is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 250R when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 250R, which may be taken as 750 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply experssed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 250R is 60,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 250R is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 250R is 400 milliamperes.

The plate characteristic curve for the 250R serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 60,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

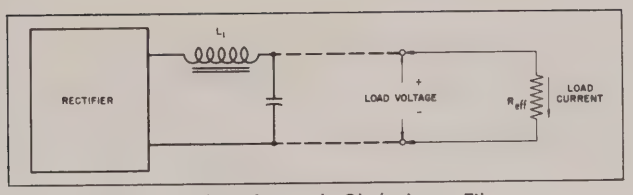
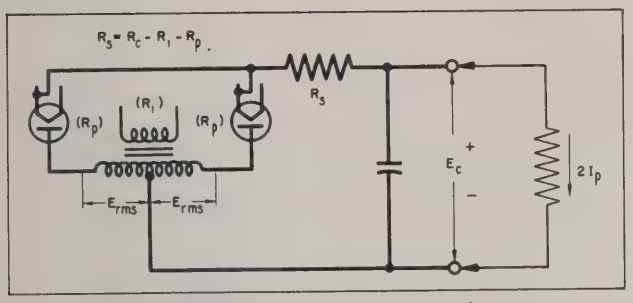
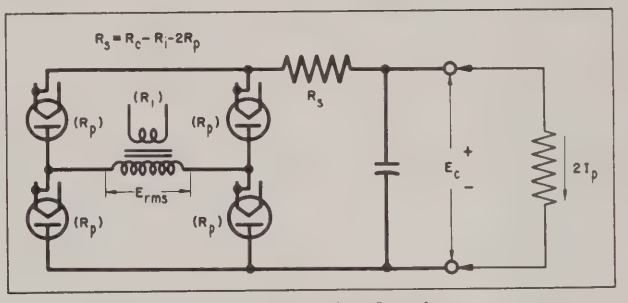


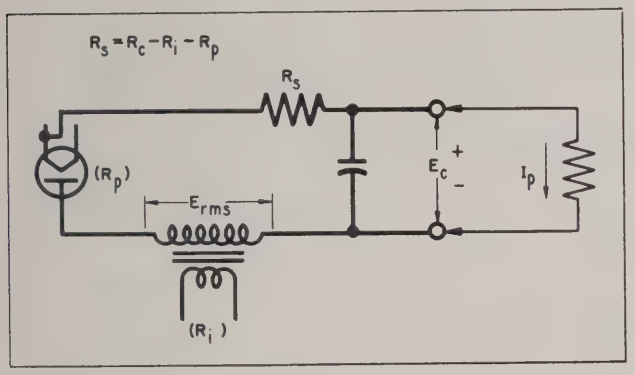
Fig. 1. Rectifier with Choke-Input Filter



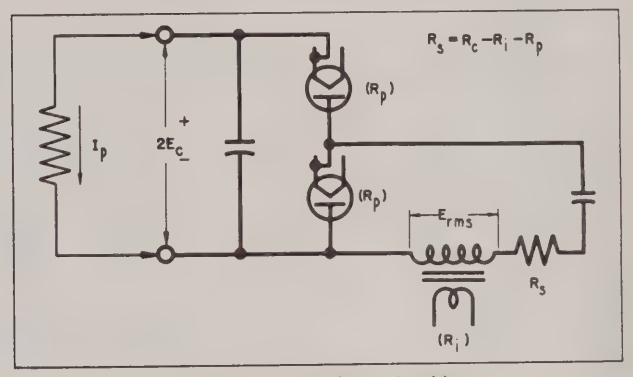
a. Full-Wave Center-Tapped Rectifier



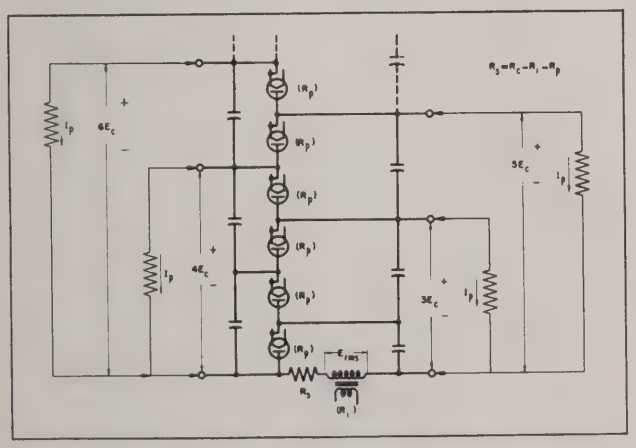
b. Full-Wave Bridge Rectifier



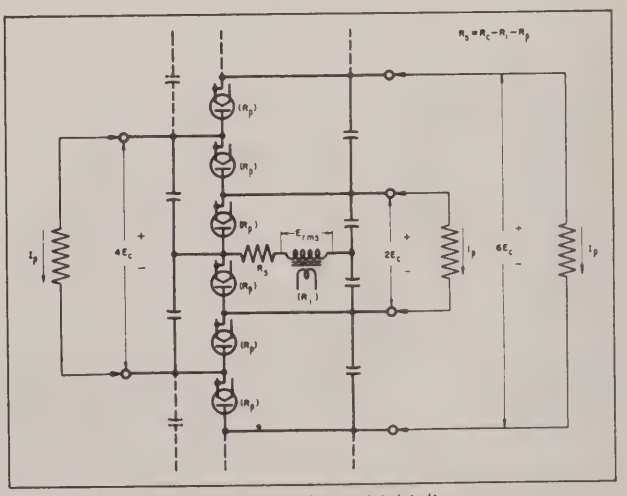
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



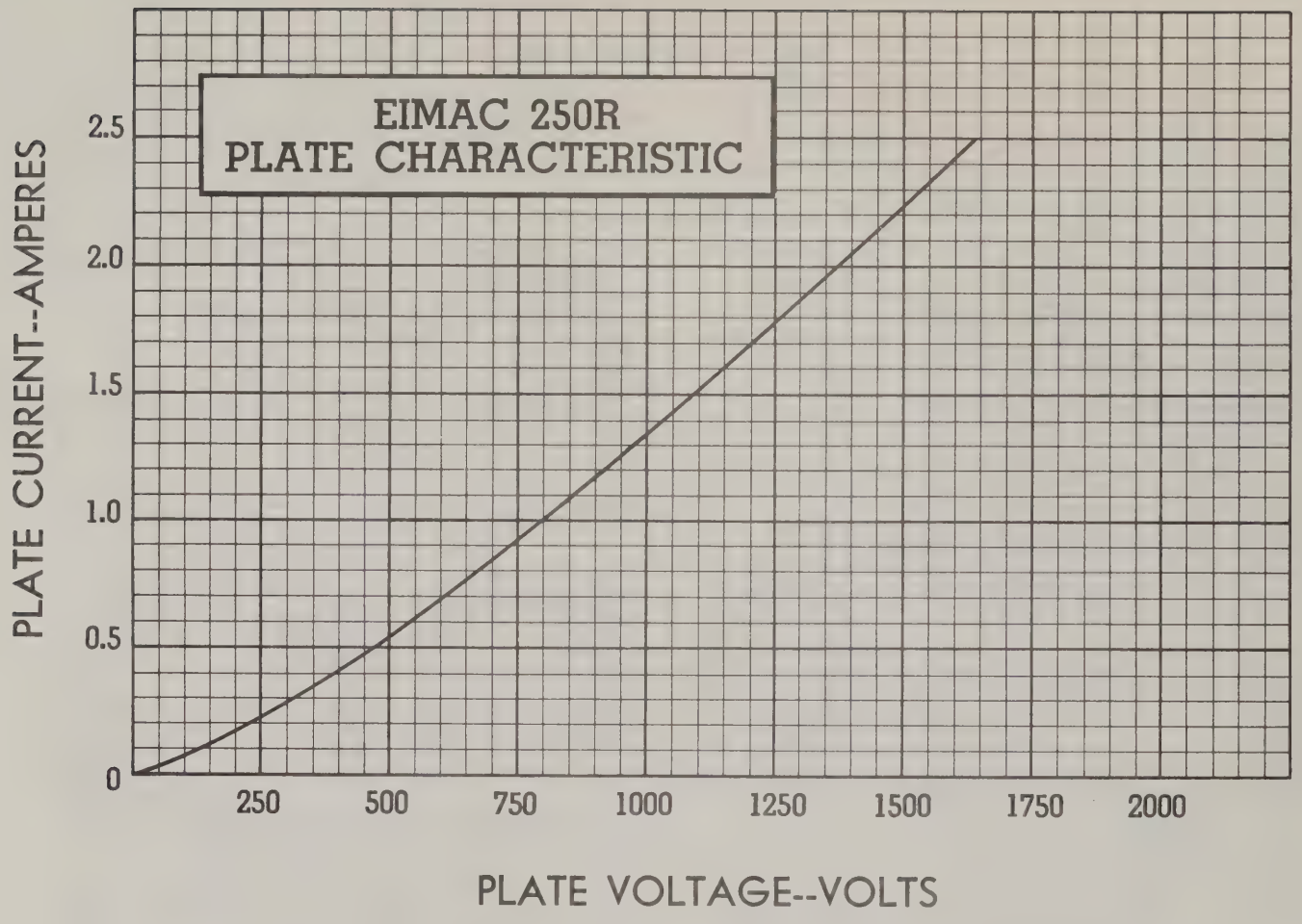
f. Full-Wave Voltage Multiplier

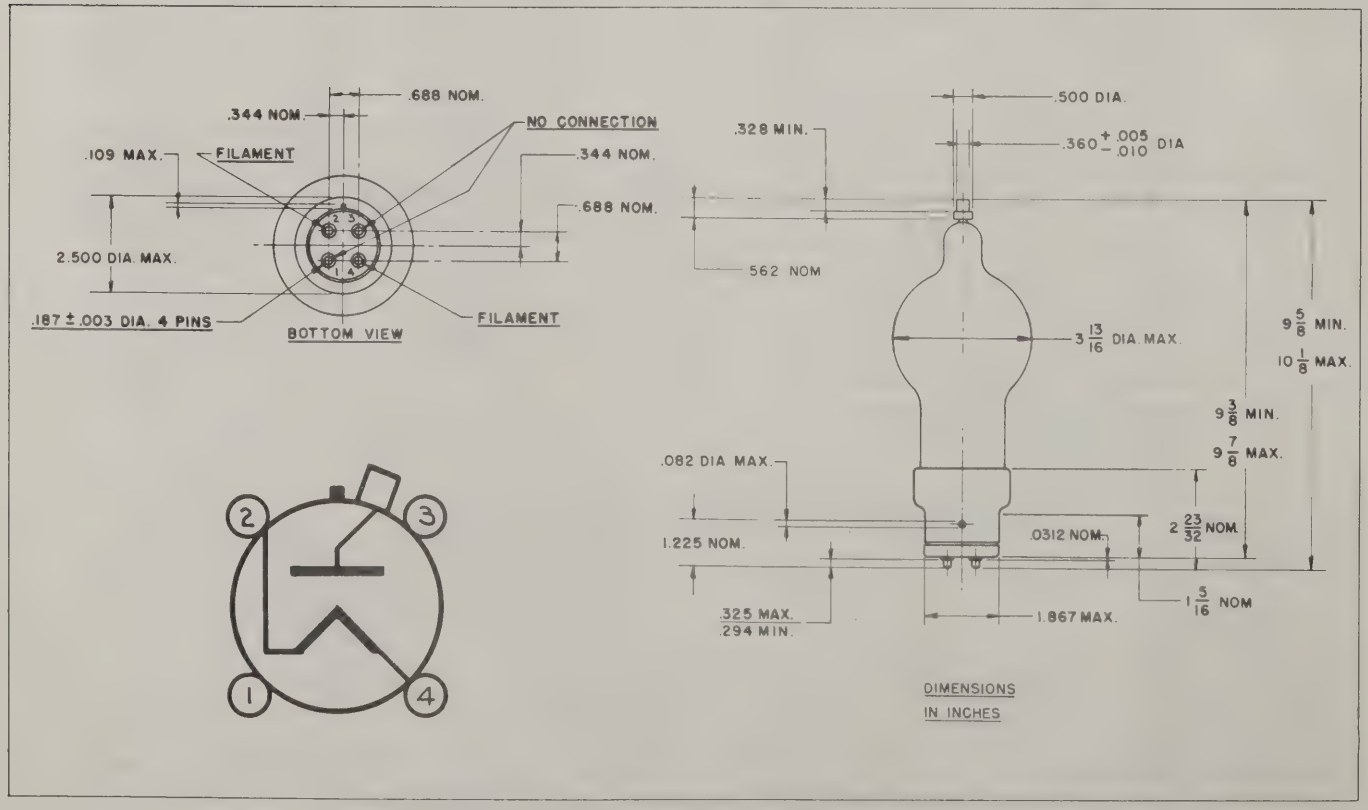
Eimac 250R Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	140	150	160	170	180	190	200	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.2	1.9	3.0	4.8	7.6	12	19	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.87	0.93	1.01	1.14	1.33	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (1/2 these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.7	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 250R Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 750 ohms (375 ohms for two tubes in parallel)





Printed in U.S.A. 1012

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

3CX2500F3

MEDIUM MU TRIODE

The Eimac 3CX2500F3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500F3 is an exact replacement for the Eimac 3X2500F3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube is equipped with flexible filament and grid leads which simplify socketing and equipment design for industrial and communication frequencies below 30 megacycles.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	48		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances:				
Grid-Plate	16.8		23.2	uuf
Grid-Filament	29.2		40.2	uuf
Plate-Filament	0.6		1.2	uuf
Transconductance (I b = 830 ma., E b = 3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			30	mc

MECHANICAL

Base	See outline drawing
Mounting	Vertical, base down or up
Maximum Anode Core and Seal Temperatures	250°C
Cooling	Forced Air
Maximum Over-all Dimensions:	
Length (Does not include filament connectors)	8.6 inches
Diameter	4.16 inches
Length of Filament Connectors (Approximate)	9.5 inches
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier,
Class-C FM or Telegraphy (Key-Down Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	5000	6000 volts
D-C Plate Current	2.5	2.5	2.08 amps
D-C Grid Voltage	−300	−450	−500 volts
D-C Grid Current	245	265	180 ma
Peak R-F Grid Input Voltage*	580	750	765 volts
Driving Power*	142	197	136 watts
Grid Dissipation*	68	78	46 watts
Plate Input Power	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Output Power	7500	10,000	10,000 watts

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier,
Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5500 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	1670 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	4500	5000 volts
D-C Plate Current	1.67	1.47	1.25 amps
D-C Grid Voltage	−450	−500	−550 volts
D-C Grid Current*	180	140	150 ma
Peak R-F Grid Input Voltage*	685	715	760 volts
Driving Power*	125	100	115 watts
Grid Dissipation*	43	30	32 watts
Plate Input Power	6670	6615	6250 watts
Plate Dissipation	1670	1315	950 watts
Plate Output Power	5000	5300	5300 watts

*Approximate values.

(Effective 9-1-64) Copyright 1964 by Eitel-McCullough, Inc.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	4000	5000	6000 volts
D-C Grid Voltage[1]	—150	—190	—240 volts
Zero-Signal D-C Plate Current	0.6	0.5	0.4 amps
Max-Signal D-C Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

Cooling —

Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 mc, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C and 50°C ambient air are tabulated below (for operation below 30 mc).

Anode-to-Base Air-Flow[1]				
	Sea Level		10,000 Feet	
Plate Dissipation* (watts)	Air-Flow (CFM)	Pressure Drop (inches H2O)	Air-Flow (CFM)	Pressure Drop (inches H2O)
2000	50	0.76	73	1.1
2500	68	1.14	99	1.7

Base-to-Anode Air-Flow				
	Sea Level		10,000 Feet	
Plate Dissipation* (watts)	Air-Flow (CFM)	Pressure Drop (inches H2O)	Air-Flow (CFM)	Pressure Drop (inches H2O)
2000	54	0.85	79	1.23
2500	77	1.35	111	1.96

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1]When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage —

The filament voltage as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts. Tube life may be extended by operation at the lower end of this range.

Bias Voltage —

There is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

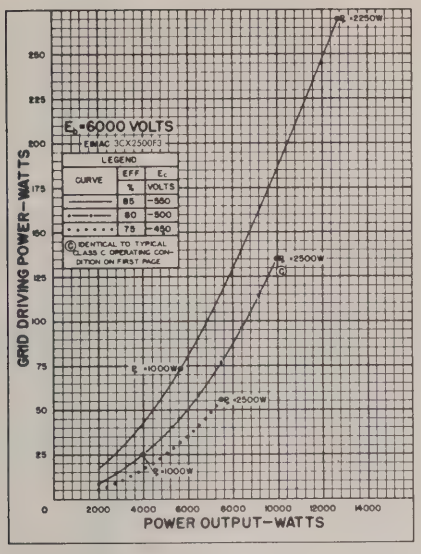
Plate Voltage —

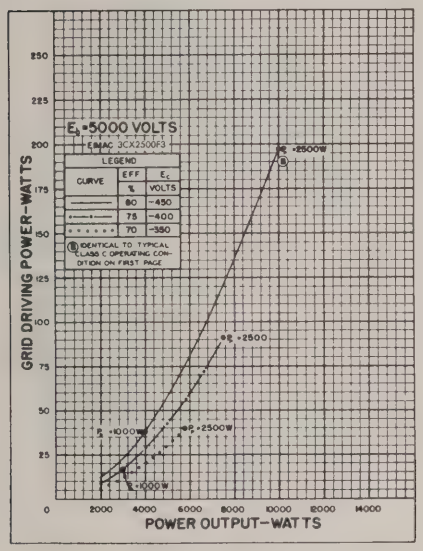
The plate-supply voltage for the 3CX2500F3 should not exceed 6000 volts. In most cases there is little advantage in using plate supply voltages higher than those given under "Typical Operation for the power output desired.

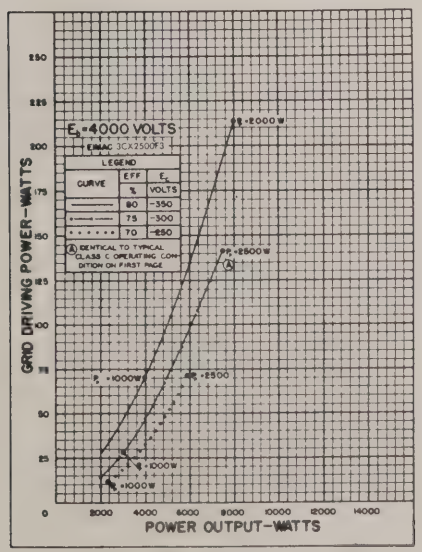
Grid Dissipation —

The power dissipated by the grid of the 3CX2500F3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

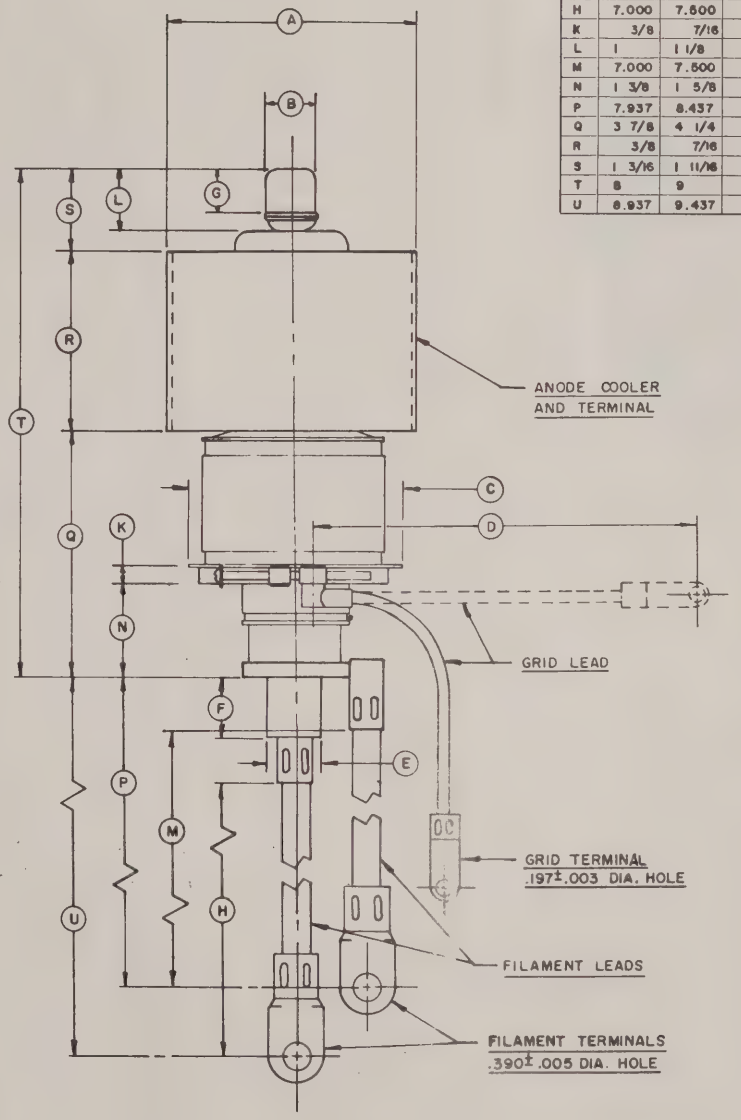
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





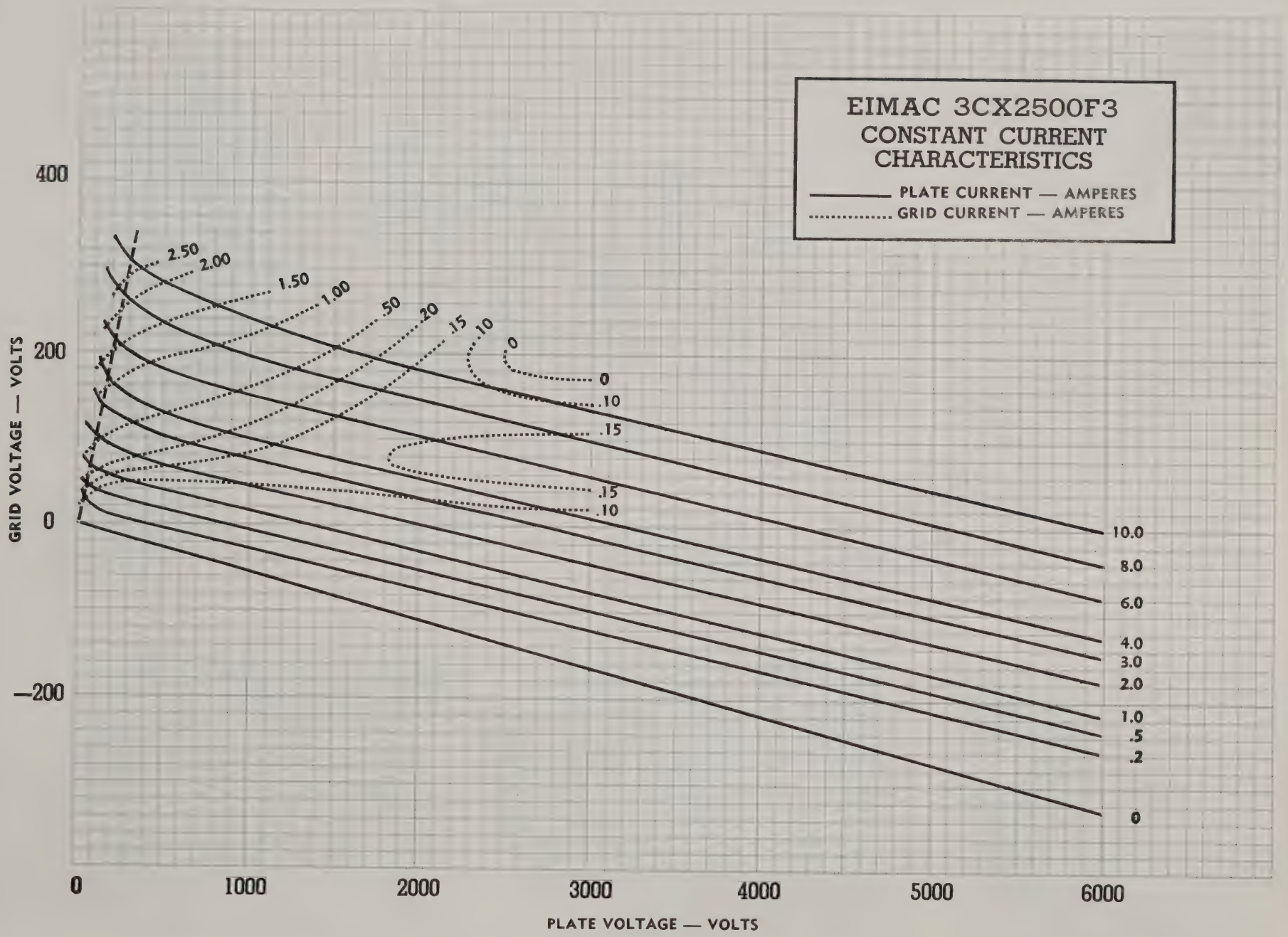


DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	11/16	13/16	
H	7.000	7.500	
K	3/8	7/16	
L	1	1 1/8	
M	7.000	7.500	
N	1 3/8	1 5/8	
P	7.937	8.437	
Q	3 7/8	4 1/4	
R	3/8	7/16	
S	1 3/16	1 11/16	
T	8	9	
U	8.937	9.437	



DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4,000, 5000 and 6000 volts respectively.


EIMAC 3CX2500F3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

8158
3CX10,000A1

LOW-MU
POWER TRIODE

The Eimac 8158/3CX10,000A1 is a ceramic and metal power triode intended primarily for use as an audio amplifier or modulator. This tube is also recommended for voltage-regulator applications where high current capability and low tube drop are important. Up to 12 kilowatts of plate power can be dissipated on its air-cooled anode. A water-cooled version, the 3CW20,000A1, is available with a 20 kw dissipation rating.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amps
Amplification Factor	5.5		7.0	
Interelectrode Capacitances:				
Grid-Filament	45		57	$\mu\mu$f
Grid-Plate	25		32	
Transconductance (Ib = 2.0 amps, Eb = 3000 volts)		20,000		umhos
Frequency for Maximum ratings			140	Mc

MECHANICAL

Base	Coaxial
Recommended Socket	Eimac SK-1300
Recommended Chimney	Eimac SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
■ Maximum Dimensions:	
Height	8.75 inches
Diameter	7.0 inches
Net Weight	12 pounds

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR CLASS-AB1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7000 MAX.	VOLTS
DC PLATE CURRENT	5.0 MAX.	AMPS
PLATE DISSIPATION	12 MAX.	KW
GRID DISSIPATION	100 MAX.	WATTS

*Adjust for zero-signal plate current
**At max-signal without negative feedback

Effective grid circuit resistance must not exceed 200,000 ohms

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000 volts
DC Grid Voltage*	-1300	-1300 volts
Zero-Sig DC Plate Current	1.5	1.5 amps
Max-Sig DC Plate Current	5.8	7.0 amps
Load Resistance, Plate-to-Plate	2460	1720 ohms
Peak AF Grid Driving Voltage (Per tube)	1300	1300 volts
Max-Sig Driving Power	0	0 watts
Max-Sig Plate Output Power	24,400	29,100 watts
Total Harmonic Distortion**	2.9	3.6 percent

(Effective 8-15-64) Copyright 1961 - 1964 by Eitel-McCullough, Inc.

■ Indicates change from data sheet dated 5-25-61

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR Class-A

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	See Class-A derating table on Page 3
PLATE DISSIPATION	12,000 MAX. WATTS

*Adjust to give listed zero-signal DC plate current

TYPICAL OPERATION

DC Plate Voltage	2500 volts
DC Grid Voltage*	—290 volts
DC Plate Current	4.0 amps
Peak AF Grid Driving Voltage	290 volts
Load Resistance	2120 ohms
Plate Output Power	1800 watts

VOLTAGE REGULATOR SERVICE
Class-A

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 MAX VOLTS
DC PLATE CURRENT	See Class-A derating table on Page 3
PLATE DISSIPATION	12,000 MAX. WATTS
GRID DISSIPATION	100 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage (tube drop)	0-5000 volts
DC Plate Current	0-5 amps

(These values are chosen according to Class-A derating table on Page 3)

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses, either input or output, has been made.

APPLICATION

Cooling — The maximum temperature rating for the external surfaces of the 3CX10, 000A1 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate** Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	85	0.18	125	0.25
6000	145	0.38	210	0.55
8000	215	0.68	315	0.99
10,000	295	1.08	430	1.60
12,000	390	1.62	565	2.35

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 100 watts, allowance has been made in preparing this tabulation for an additional 850 watts dissipation.

APPLICATION

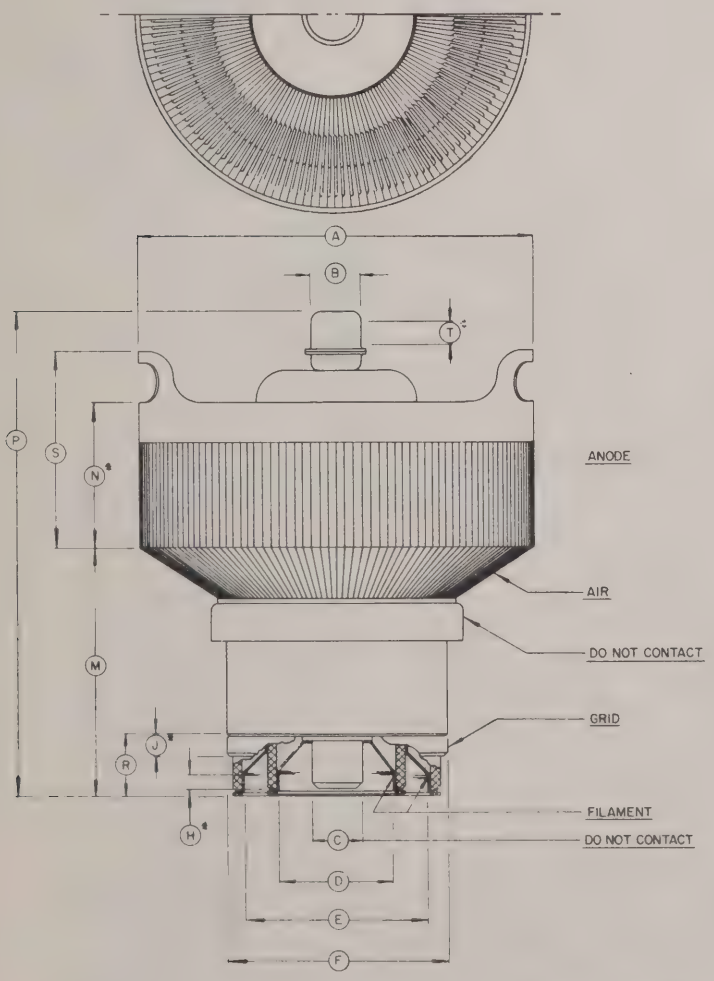
Voltage-Regulator Service — Maximum DC plate current and voltage are restricted according to the following table.

CLASS-A DERATING TABLE	
DC Plate Voltage (Volts)	Max. DC Plate Current (mA)
0 - 2400	5000
3000	4000
4000	3000
5000	2000
6000	1500
7000	1000
8000	700
9000	500
10,000	350

Filament Operation—The rated filament voltage for the 3CX10,000A1 is 7.5 volts. Filament voltage, as measured at the socket, should not be allowed to deviate from the rated value by more than plus or minus five percent.

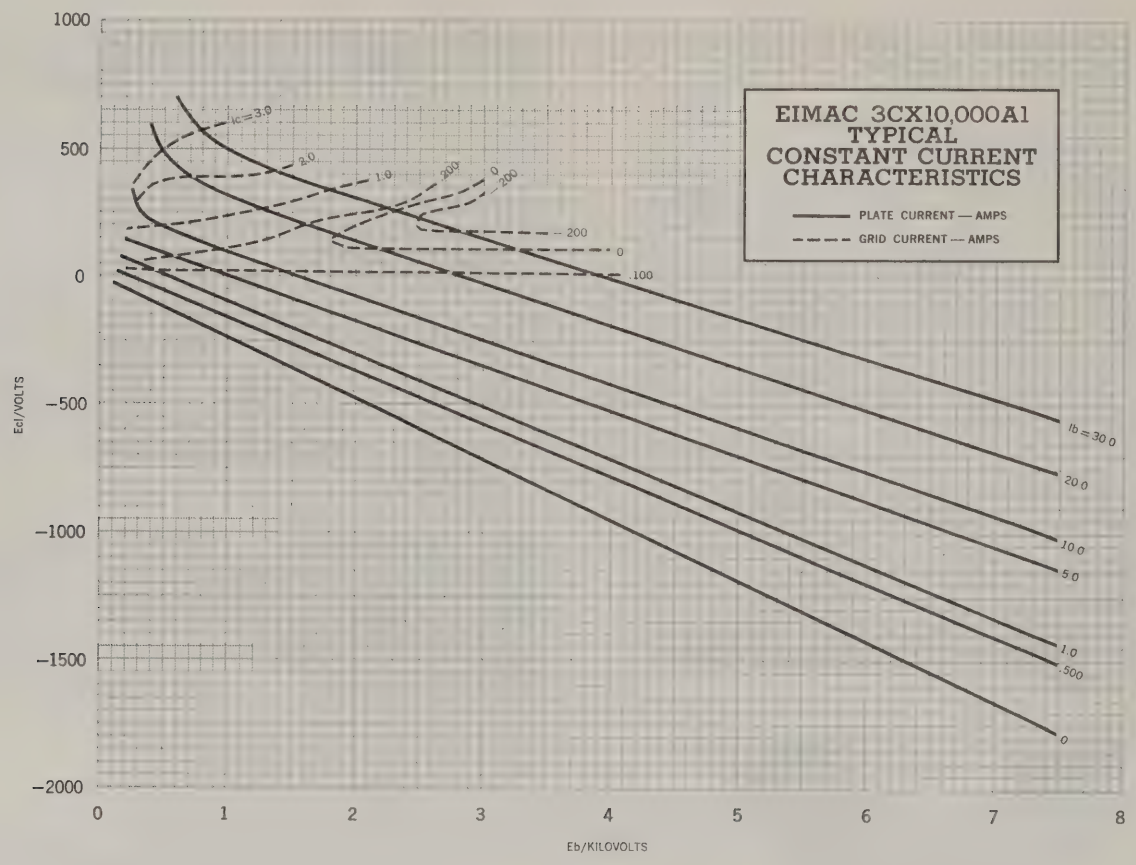
Cooling—The maximum temperature rating for the external surfaces of the 3CX10,000A1 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the ceramic-metal seals and anode core below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates provides effective cooling of the tube. When air-flow is in the anode-to-base direction, special care must be taken to insure adequate cooling of the filament stem structure. A separate supply of air may have to be directed into the area between the filament contact areas to maintain safe seal temperatures.

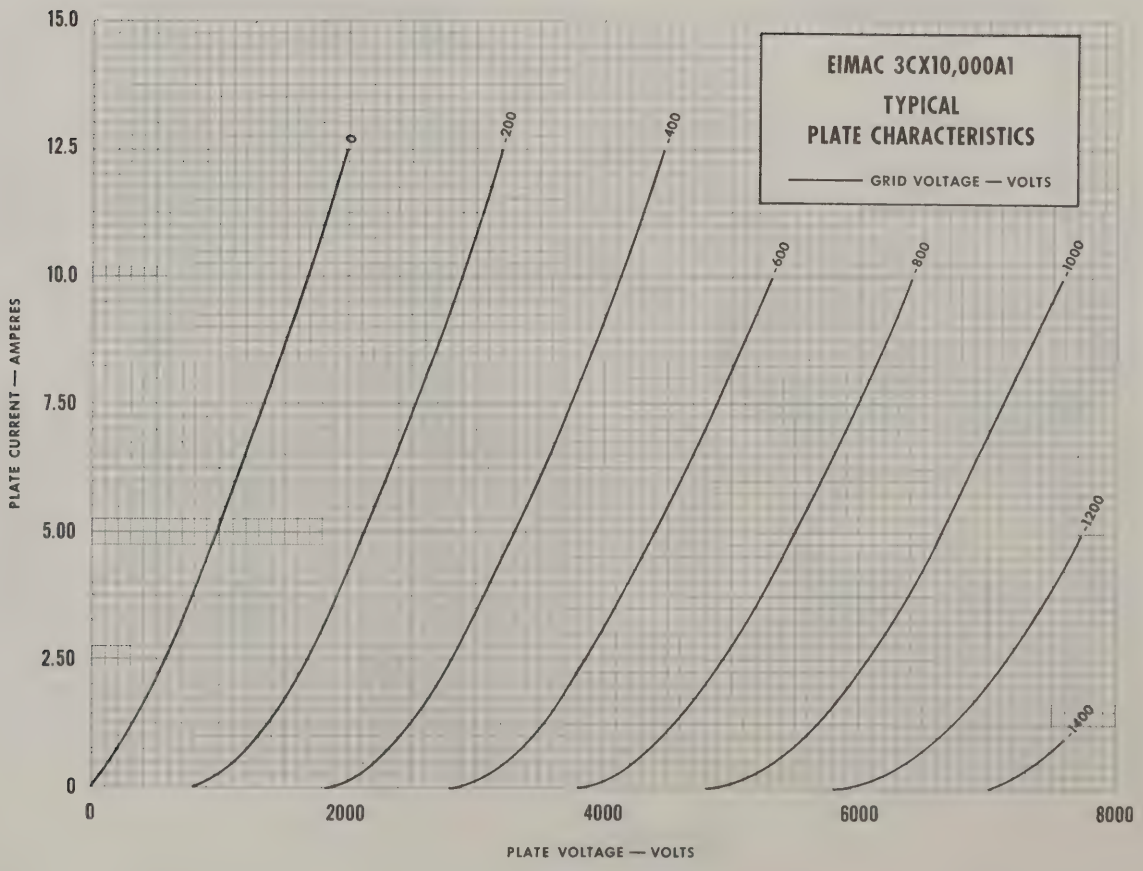
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, Calif., for information and recommendations.



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3 133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	





Printed in U.S.A.

EITEL-McCULLOUGH, INC.

8159

3CX10,000A3

MEDIUM-MU POWER TRIODE

The Eimac 3CX10,000A3 is a ceramic and metal power triode intended primarily for use as a power oscillator in industrial-heating applications. It is also recommended for use as a grounded-grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage	-	7.5	-	volts
Current	94	-	104	amperes
Amplification Factor	-	20	-	
Interelectrode Capacitances, Grounded Cathode:				
Input	48	-	58	μμf
Output	1.2	-	1.5	μμf
Feedback	30	-	38	μμf
Frequency for Maximum Ratings	-	-	-	140 Mc

MECHANICAL	
Base	Coaxial
Recommended Socket	Eimac SK-1300
Recommended Chimney	Eimac SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	8.5 inches
Diameter	7.0 inches
Net Weight	12 pounds

R-F INDUSTRIAL OSCILLATOR CLASS-C

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	7000 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	10 MAX. KW
GRID DISSIPATION	250 MAX. WATTS

TYPICAL OPERATION, Optimum Load

D-C Plate Voltage	6000	7000 volts
D-C Grid Voltage	-575	-670 volts
D-C Plate Current	4.0	4.0 amps
D-C Grid Current	610	670 ma
Plate Input Power	24	28 kw
Plate Output Power	18.9	22.4 kw

R-F POWER AMPLIFIER GROUNDED-GRID, CLASS-C

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	7000 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	10 MAX. KW
GRID DISSIPATION	250 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000 volts
D-C Grid Voltage	-535	-625 volts
D-C Plate Current	4.0	4.0 amps
D-C Grid Current	545	530 ma
Driving Power	3700	4100 watts
Plate Output Power	20.5	24.5 kw

(Effective 8-15-64 Copyright 1961-1964 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 7-1-61

R-F POWER AMPLIFIER
PLATE-MODULATED, CLASS-C

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	5500 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPS
PLATE DISSIPATION	6.5 MAX. KW
GRID DISSIPATION	250 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	4000	5000 volts
D-C Grid Voltage	-480	-600 volts
D-C Plate Current	3.0	3.0 amps
D-C Grid Current	660	550 ma
Driving Power	530	515 watts
Plate Output Power	9.7	12.4 kw

R-F LINEAR AMPLIFIER
GROUNDED-GRID, CLASS-AB2

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	7000 MAX. VOLTS
D-C PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	12 MAX. KW
GRID DISSIPATION	250 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000 volts
Zero-Sig Grid Voltage*	-270	-325 volts
Max-Sig D-C Plate Current	4.0	4.0 amps
Max-Sig D-C Grid Current	300	250 ma
Driving Power	1900	2050 watts
Plate Output Power	18	20 kw

*Adjust to give 500 milliamperes zero-signal d-c plate current.

Note: "TYPICAL OPERATION" data are obtained by caluclation from published characteristics curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

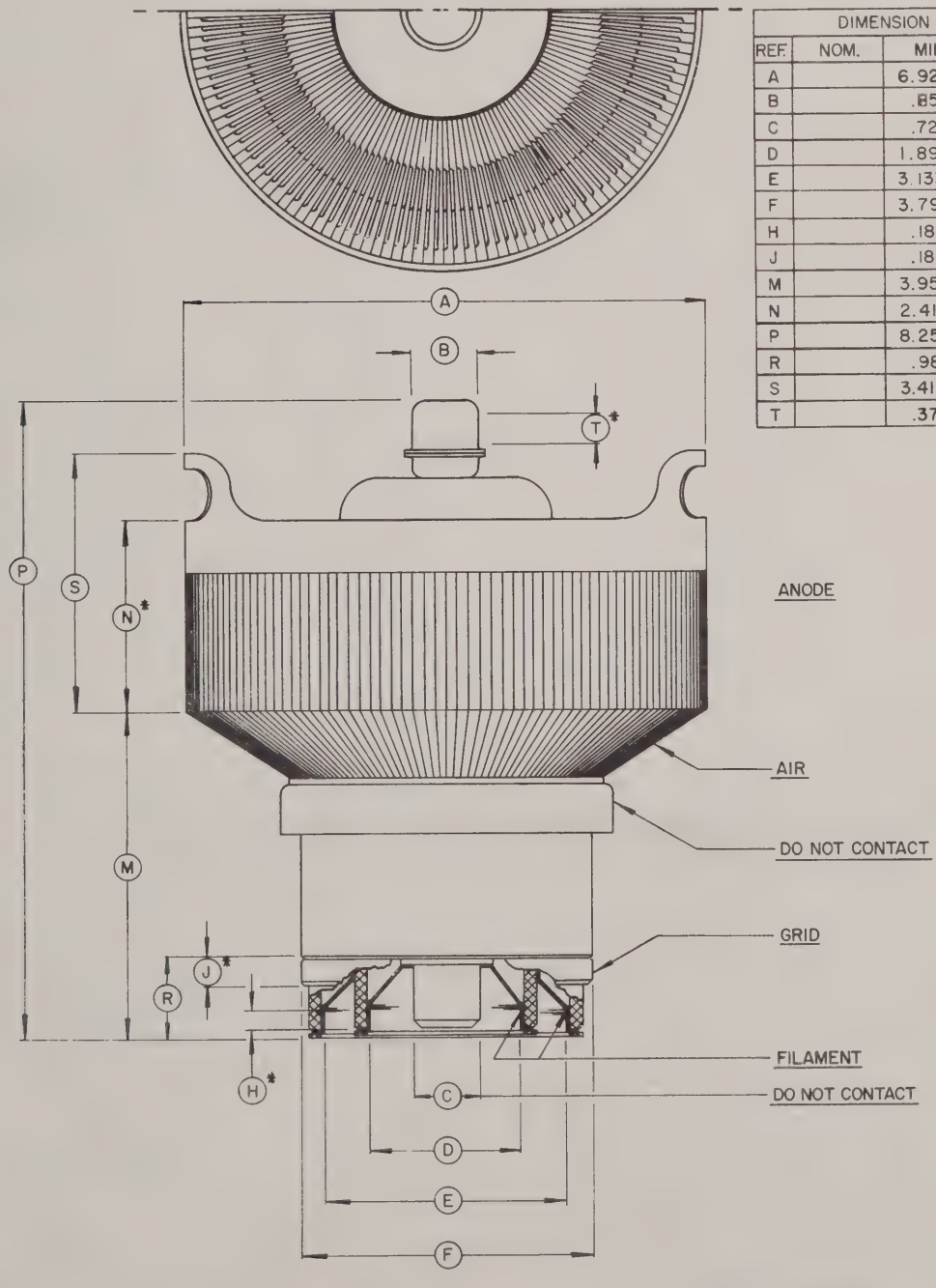
Cooling - The maximum temperature rating for the external surfaces of the 3CX10,000A3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

	Sea Level		10,000 Feet	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	85	0.18	125	0.25
6000	145	0.38	210	0.55
8000	215	0.68	315	0.99
10,000	295	1.08	430	1.60
12,000	390	1.62	565	2.35

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 250 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

Filament Operation - The rated filament voltage for the 3CX10,000A3 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than five percent.

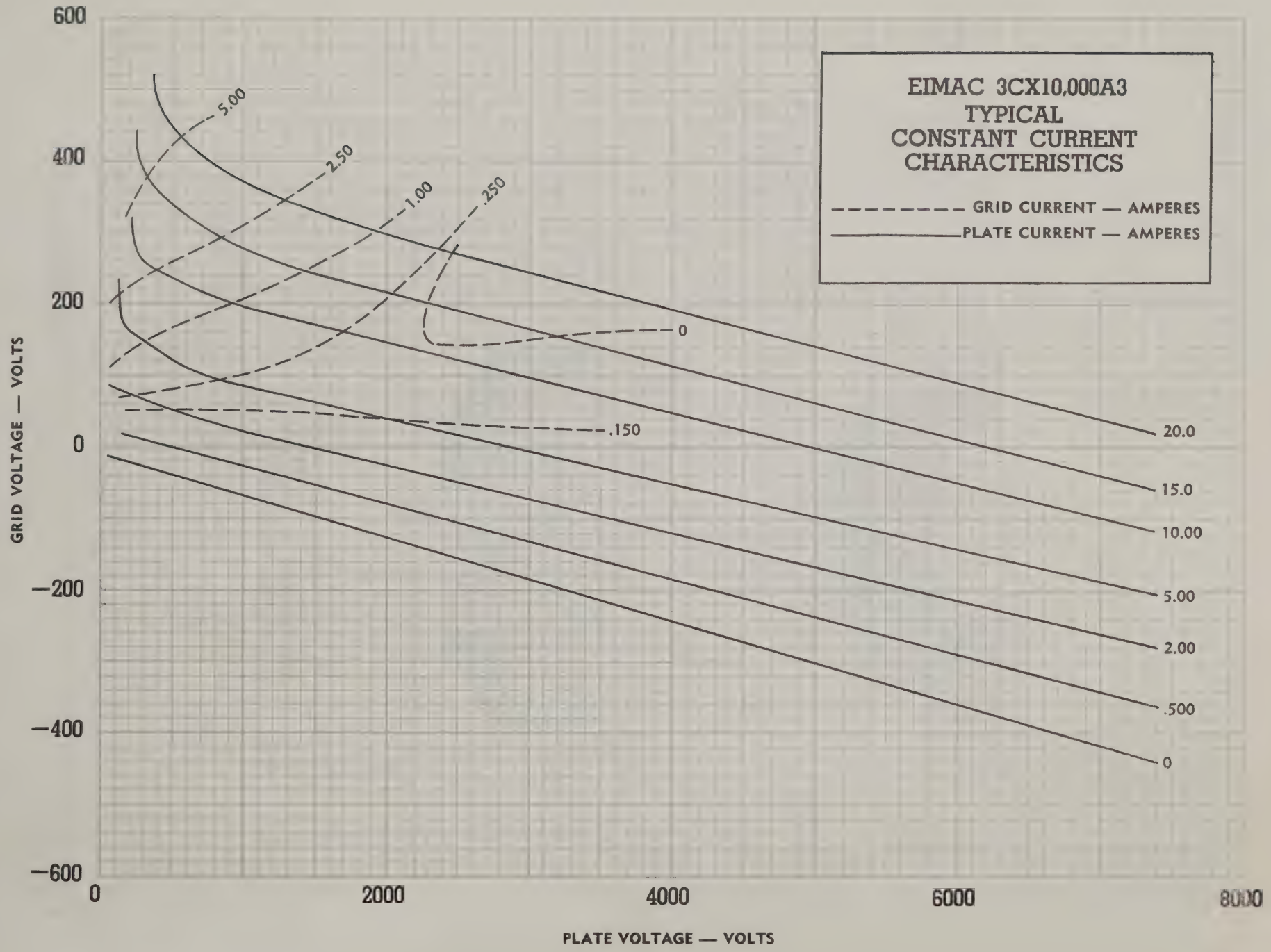
Special Applications - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	

*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

▶ Indicates change from sheet dated 7-1-61


EIMAC 3CX10,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
0
2000
4000
6000
8000
5.00
2.50
1.00
.250
0
.150
20.0
15.0
10.00
5.00
2.00
.500
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

304TL

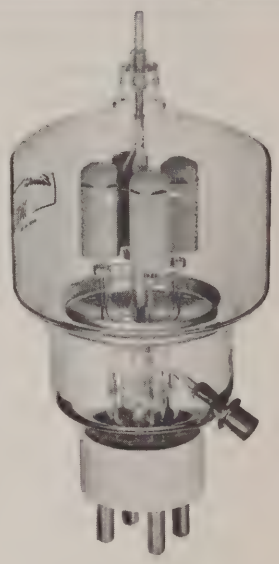
LOW-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 304TL is a low-mu, power triode having a maximum plate dissipation rating of 300 watts, and is intended for use as an amplifier, oscillator or modulator, where maximum performance can be obtained at low plate voltage. It can be used at its maximum ratings at frequencies as high as 40-Mc.

Cooling of the 304TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 or 10.0 volts
Current	25.0 or 12.5 amperes
Amplification Factor (Average)	12
Direct Interelectrode Capacitances (Average)	
Grid-Plate	8.6 $\mu\mu f$
Grid-Filament	12.1 $\mu\mu f$
Plate-Filament	.8 $\mu\mu f$
Transconductance (i_b=1.0 amp., E_b=3000 v, e_c= —175v.)	16,700 μmhos
Frequency for Maximum Ratings	40 Mc.

MECHANICAL

Base	Special 4 pin, No. 5000B
Socket	Johnson No. 124-213 or Equivalent
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connectors:	
Plate	HR-7
Grid	HR-6
Maximum Overall Dimensions:	
Length	7.625 inches
Diameter	3.563 inches
Net weight	9 ounces
Shipping weight (Average)	2 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	900 MAX. MA.
PLATE DISSIPATION, PER TUBE	300 MAX. WATTS

TYPICAL OPERATION, CLASS AB$_1$

D-C Plate Voltage	1500	2000	2500	3000	Volts
D-C Grid Voltage (approx.)*	—118	—170	—230	—290	Volts
Zero-Signal D-C Plate Current	270	200	160	130	Ma.
Max-Signal D-C Plate Current	572	546	483	444	Ma.
Effective Load, Plate-to-Plate	2540	5300	8500	12,000	Ohms
Peak A-F Grid Input Voltage (per tube)	118	170	230	290	Volts
Max-Signal Peak Driving Power	0	0	0	0	Watts
Max-Signal Plate Power Output	256	490	610	730	Watts

*Adjust to give stated zero-signal plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION, CLASS AB$_2$

D-C Plate Voltage	1500	2000	2500	3000	Volts
D-C Grid Voltage (approx.)*	—118	—170	—230	—290	Volts
Zero-Signal D-C Plate Current	270	200	160	130	Ma.
Max-Signal D-C Plate Current	1140	1000	900	800	Ma.
Effective Load, Plate-to-Plate	2750	4500	6600	9100	Ohms
Peak A-F Grid Input Voltage (per tube)	245	290	340	390	Volts
Max-Signal Peak Driving Power	78	87	95	110	Watts
Max-Signal Nominal Driving Power (approx.)	39	44	48	55	Watts
Max-Signal Plate Power Output	1100	1400	1650	1800	Watts

*Adjust to give stated zero-signal plate current.

(Effective 8-15-64) Copyright 1958-64 by Eitel-McCullough, Inc.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C PLATE CURRENT	700 MAX. MA.
PLATE DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

TYPICAL OPERATION (Power input limited to 500 and 1000 watts)*

D-C Plate Voltage	2000	2000	2500	2500	Volts
D-C Plate Current	250	500	200	400	Ma.
Total Bias Voltage	—500	—500	—525	—550	Volts
Fixed Bias Voltage	—410	—275	—300	—300	Volts
Grid Resistor	3000	3000	12,500	5000	Ohms
D-C Grid Current	30	75	18	50	Ma.
Peak R-F Grid Input Voltage	615	690	620	715	Volts
Driving Power	18	52	11	36	Watts
Grid Dissipation	3	15	2	9	Watts
Plate Power Input	500	1000	500	1000	Watts
Plate Dissipation	90	190	75	170	Watts
Plate Power Output	410	810	425	830	Watts

*The figures are for convenience in obtaining a 500 or 1000 Watt carrier input per tube to the modulated amplifier. The output figures do not allow for circuit losses.

TYPICAL OPERATION*

D-C Plate Voltage	1500	2000	2500	Volts
D-C Plate Current	520	525	450	Ma.
Total Bias Voltage	—370	—500	—550	Volts
Fixed Bias Voltage	—160	—260	—440	Volts
Grid Resistor	2800	3000	2000	Ohms
D-C Grid Current	75	80	55	Ma.
Peak R-F Grid Input Voltage	545	695	720	Volts
Driving Power	41	55	40	Watts
Grid Dissipation	13	15	10	Watts
Plate Power Input	780	1050	1125	Watts
Plate Dissipation	200	200	200	Watts
Power Output	580	850	925	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class C amplifier. The output figures do not allow for circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

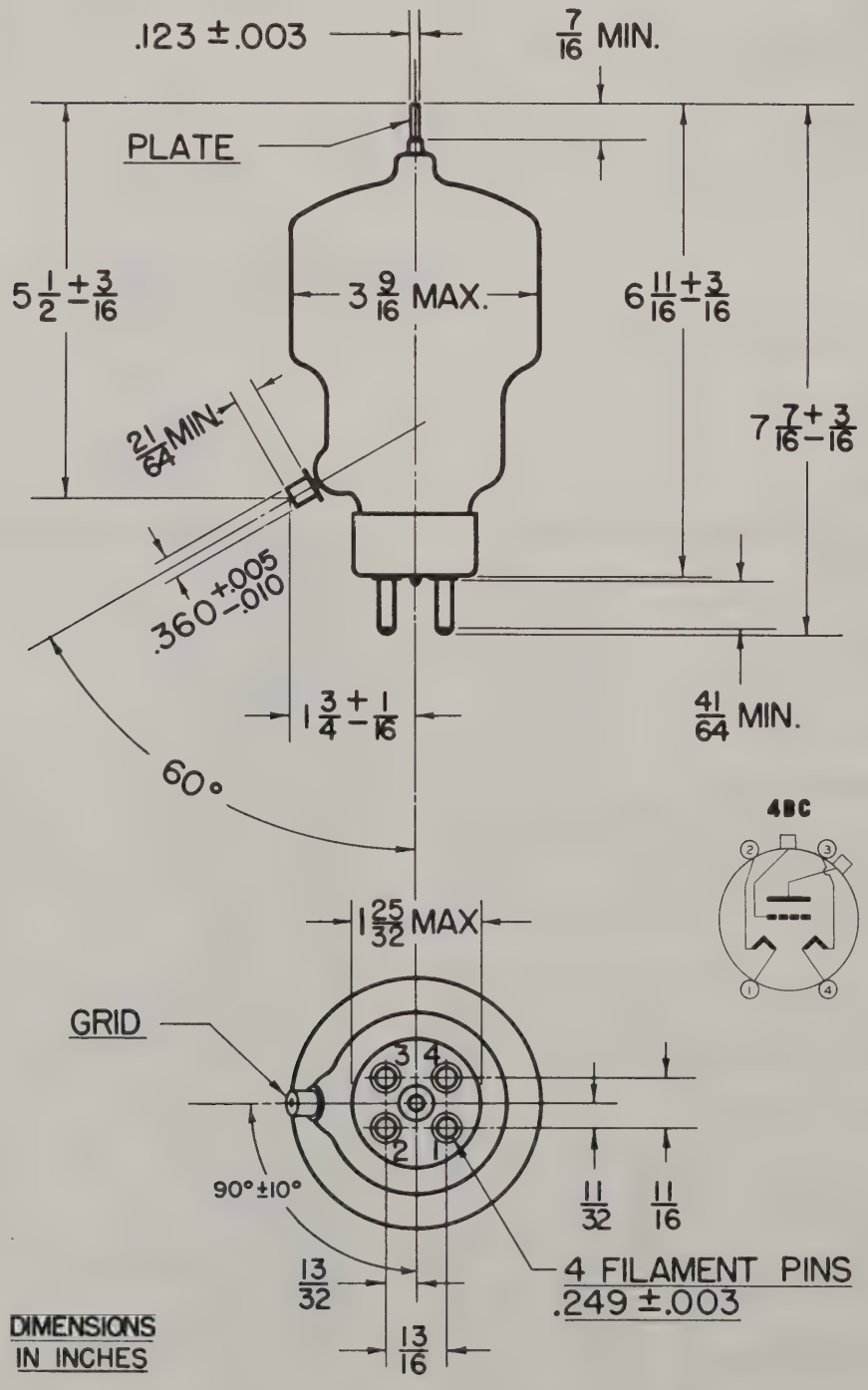
MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	900 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

TYPICAL OPERATION*

D-C Plate Voltage	1500	2000	3000 Volts
D-C Grid Voltage	—250	—300	—400 Volts
D-C Plate Current	665	600	500 Ma.
D-C Grid Current	90	85	80 Ma.
Peak R-F Grid Input Voltage	430	480	575 Volts
Driving Power (approx.)	33	36	40 Watts
Grid Dissipation	11	11	8 Watts
Plate Power Input	1000	1200	1500 Watts
Plate Dissipation	300	300	300 Watts
Plate Power Output	700	900	1200 Watts

*The figures show actual measured tube performance, and do not allow for circuit losses.

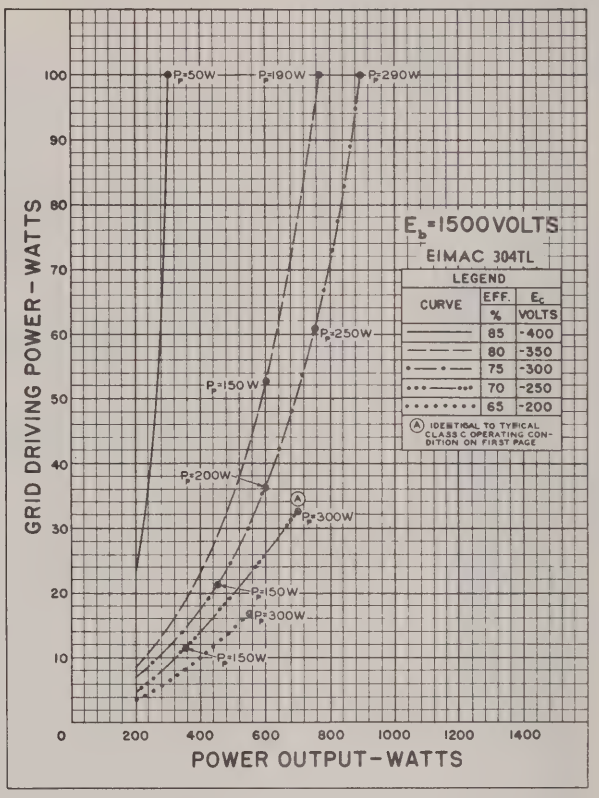


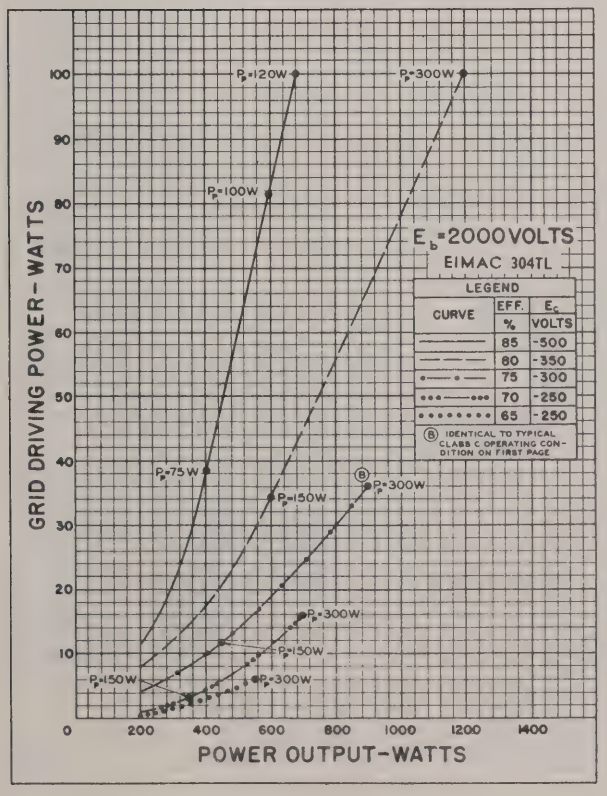
▶ Indicates change from sheet dated 5-1-49

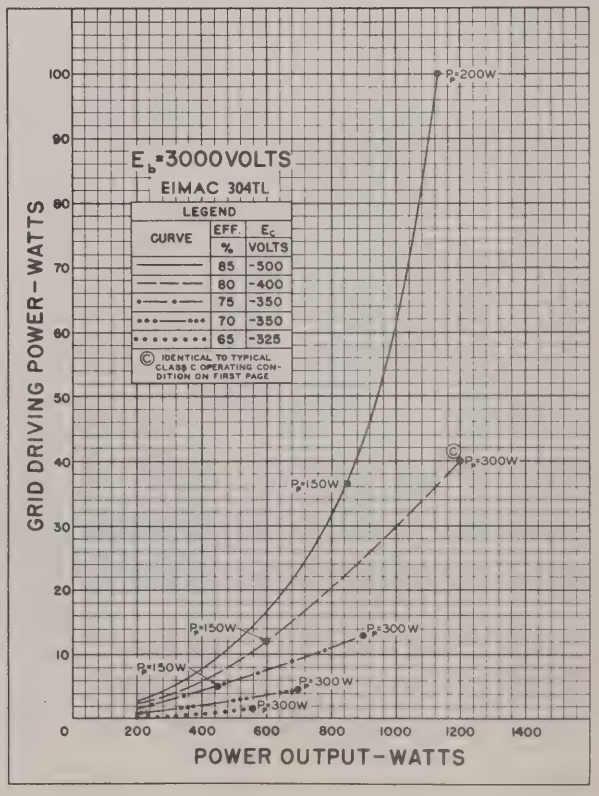
DRIVING POWER vs. POWER OUTPUT

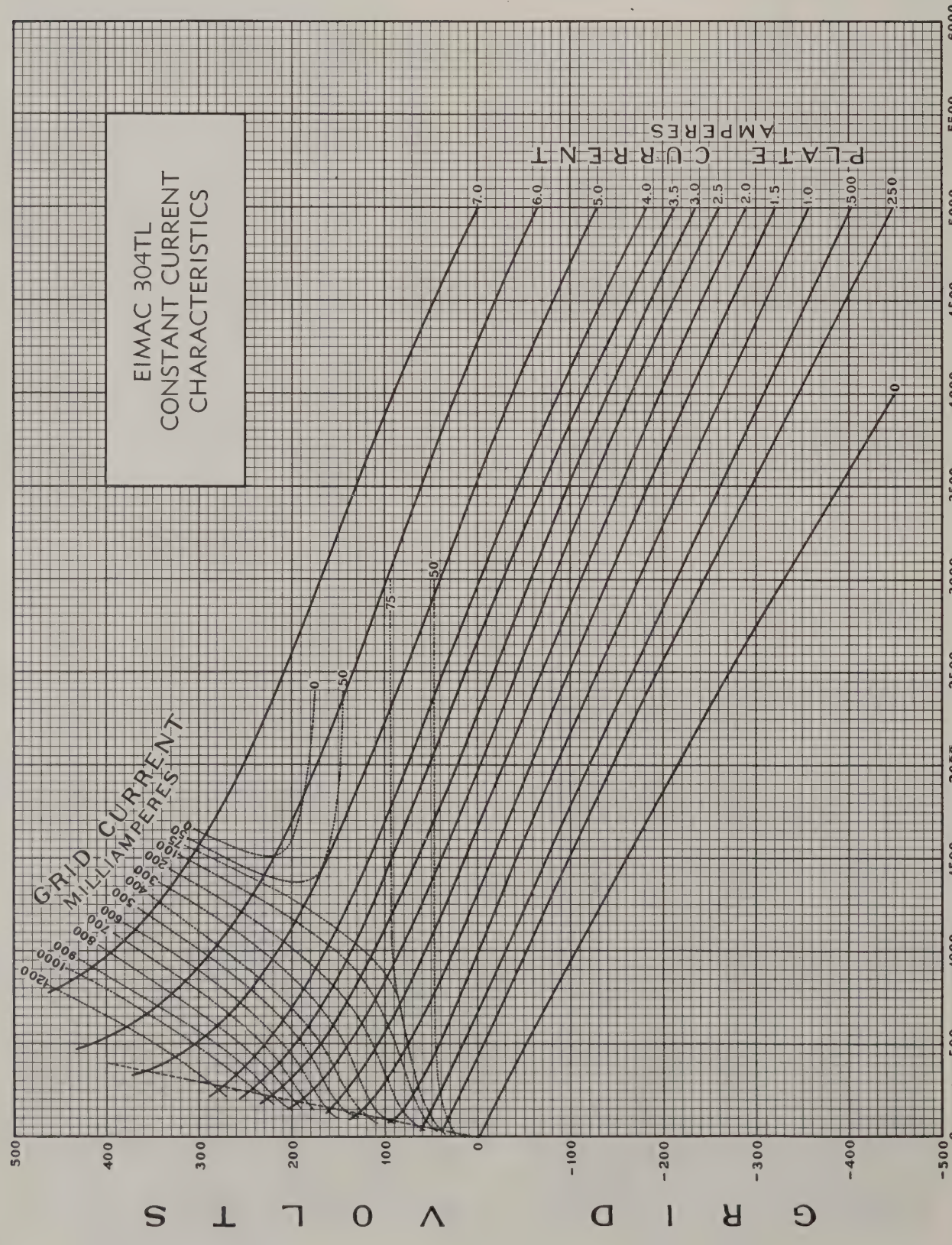
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.









Printed in U.S.A.

Eimac

EITEL-McCULLOUGH, INC.

6696A

WATER COOLED MEDIUM-MU POWER TRIODE



The Eimac 6696A is a water cooled ceramic-metal triode designed for industrial heating service. It is recommended also for use in broadcast and communications amplifiers.

Low-loss ceramic and metal construction permits operation at full ratings at frequencies up to 40 Mc. Useful power output can be obtained at frequencies up to 80 Mc at reduced plate voltage.

The 6696A anode is capable of dissipating 60 kilowatts at a moderate rate of water flow. A forced-air cooled version of this tube, type 6697A, and a vapor cooled version, type 7480, are also available.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.
Filament: Thoriated-Tungsten			
Voltage		13	volts
Current	190		220 amperes
Amplification Factor		20	
Direct Interelectrode Capacitances			
Grid-Plate	47		57 pf
Grid-Filament	65		85 pf
Plate-Filament	2.0		3.2 pf
Frequency for Maximum Ratings			40 Mc

MECHANICAL

Base	Coaxial
Operating Position	Vertical, base up
Cooling	Water and forced air
Maximum Seal Temperature	200°C
Maximum Outlet Water Temperature	70°C
Maximum Height	19.4 inches
Maximum Diameter	4.72 inches
Net Weight	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	11 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION

DC Plate Voltage	10	15 kV
DC Grid Voltage	—1200	—1600 volts
Peak RF Grid Voltage	1900	2100 volts
DC Plate Current	10.0	7.0 amps
DC Grid Current	810	300 mA
Resonant Load Impedance	440	970 ohms
Driving Power, approx.	1500	600 watts
Plate Output Power, approx.	72	80 kW

(Effective 10-15-64) Copyright 1964 by Eitel-McCullough, Inc.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	8.5 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	40 KW

TYPICAL OPERATION

DC Plate Voltage	9.5 kV
DC Grid Voltage	—1600 volts
Peak RF Grid Voltage	2300 volts
DC Plate Current	8.4 amps
DC Grid Current	900 mA
Resonant Load Impedance	510 ohms
Driving Power, approx.	2.0 kW
Plate Output Power, approx.	60 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (Two Tubes).

DC Plate Voltage	10	12 kV
DC Grid Voltage	—450	—600 volts
Peak AF Driving Voltage (per tube)	875	1060 volts
Zero-Sig DC Plate Current	3.0	2.0 amps
Max-Sig DC Plate Current	17.4	20.0 amps
Load Resistance, Plate-to-Plate	1170	1230 ohms
Max-Sig Driving Power, approx.	550	600 watts
Max-Sig Plate Output Power, approx.	110	152 kW

RADIO-FREQUENCY AM LINEAR AMPLIFIER

Class-AB (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	9.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (AM Carrier conditions except where noted).

DC Plate Voltage	12	12 kV
DC Grid Voltage	—550	—550 volts
Peak RF Grid Voltage	510	640 volts
DC Plate Current	4.3	6.8 amps
DC Grid Current	0	0 amps
Resonant Load Impedance	780	500 ohms
Driving Power, approx.*	450	1500 watts
Plate Output Power, approx.	18	28 kW

*At modulation crest.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB, Single-Sideband Suppressed-Carrier Service

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (Peak-envelope or modulation-crest conditions in cathode-drive circuit).

DC Plate Voltage	12	12 kV
DC Cathode Voltage	600	600 volts
Peak RF Driving Voltage	830	1020 volts
DC Plate Current	5.2	9.8 amps
DC Grid Current, approx.	60	200 mA
Resonant Load Impedance	880	700 ohms
Driving Power, approx.	3.5	8.2 kW
Plate Power Output, approx.	43	83 kW

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

MECHANICAL

Mounting—

The 6696A should be mounted vertically anode down in the waterjacket (Machlett type F-17393 or equivalent). Filament and grid connections are made through clamp rings or spring-finger contacts to the O.D. of the sturdy copper terminals of the tube. Satisfactory anode contact can be made to the water jacket.

Anode Cooling—

Minimum cooling requirements are given in the accompanying table, where the pressure drop is measured at the jacket fittings. The water supply line must be connected to the inlet fitting of the water jacket.

MINIMUM ANODE COOLING REQUIREMENTS

Plate Dissipation kW	Water Flow Rate gpm	Pressure Drop psi
20	5.7	1.3
30	8.0	2.1
40	11.2	3.3
50	14.5	5.0
60	18.0	7.2

Base Cooling—

Forced-air cooling of the ceramic base and seals may be required, depending on ambient conditions and operating frequency. Air flow rate and direction should be determined to limit envelope temperatures to 200°C maximum and to maintain uniform temperature distribution around the seals. Spot temperatures are conveniently measured with Tempilaq (spray type) or equivalent. Often a flow of about 100 cfm, directed axially downward towards the tube, is sufficient.

ELECTRICAL

Filament Operation—

The rated filament voltage, as measured at the tube terminals, should be maintained within ±5% to assure long life and good performance within the rated power capability of the tube. To accommodate special requirements, the filament voltage may be centered near either of these extremes, e.g. at plus 5 percent for exceptionally high emission at a sacrifice of life, or at minus 5 percent for exceptionally long life where perhaps only half the full emission capability is required.

Grid Dissipation—

Grid dissipation should be limited to 1,000 watts maximum. Grid dissipation may be calculated approximately as the product of peak positive grid voltage and dc grid current.

In many r-f amplifier applications where it is impractical to measure the positive grid voltage, the dc grid current rating serves as a satisfactory guide. The maximum dc grid current rating under normal full load conditions is 2 amperes. In most cases, however, high power output and good efficiency can be realized with grid current less than one ampere. By limiting the grid current in this manner there is obviously more latitude for grid current excursions resulting from changes in loading.

High Frequency Operation—

The maximum ratings listed apply at frequencies up to 40 Mc. Useful output can be obtained at higher frequencies if the plate voltage and plate input power are reduced accordingly. For operation up to 60 Mc these parameters should be reduced to 75% of the listed dc plate voltage rating; for operation up to 80 Mc they should be reduced to 50%.

Aging—

The manner of operating most high power tubes differs in at least some respects from conditions under which the tubes are tested, therefore, some aging is almost always required to condition a new tube to its new environment. In basic terms, the different operating conditions are manifest as different distributions of heat and voltage gradients. Satisfactory aging is most easily achieved by gradual application of voltages, e.g. first filament voltage, then partial plate voltage, and drive, working up to the final values. If continuous or stepped plate voltage control is not used, sufficient load should be connected before snapping on full voltage to limit transients to about 120% of the dc voltage.

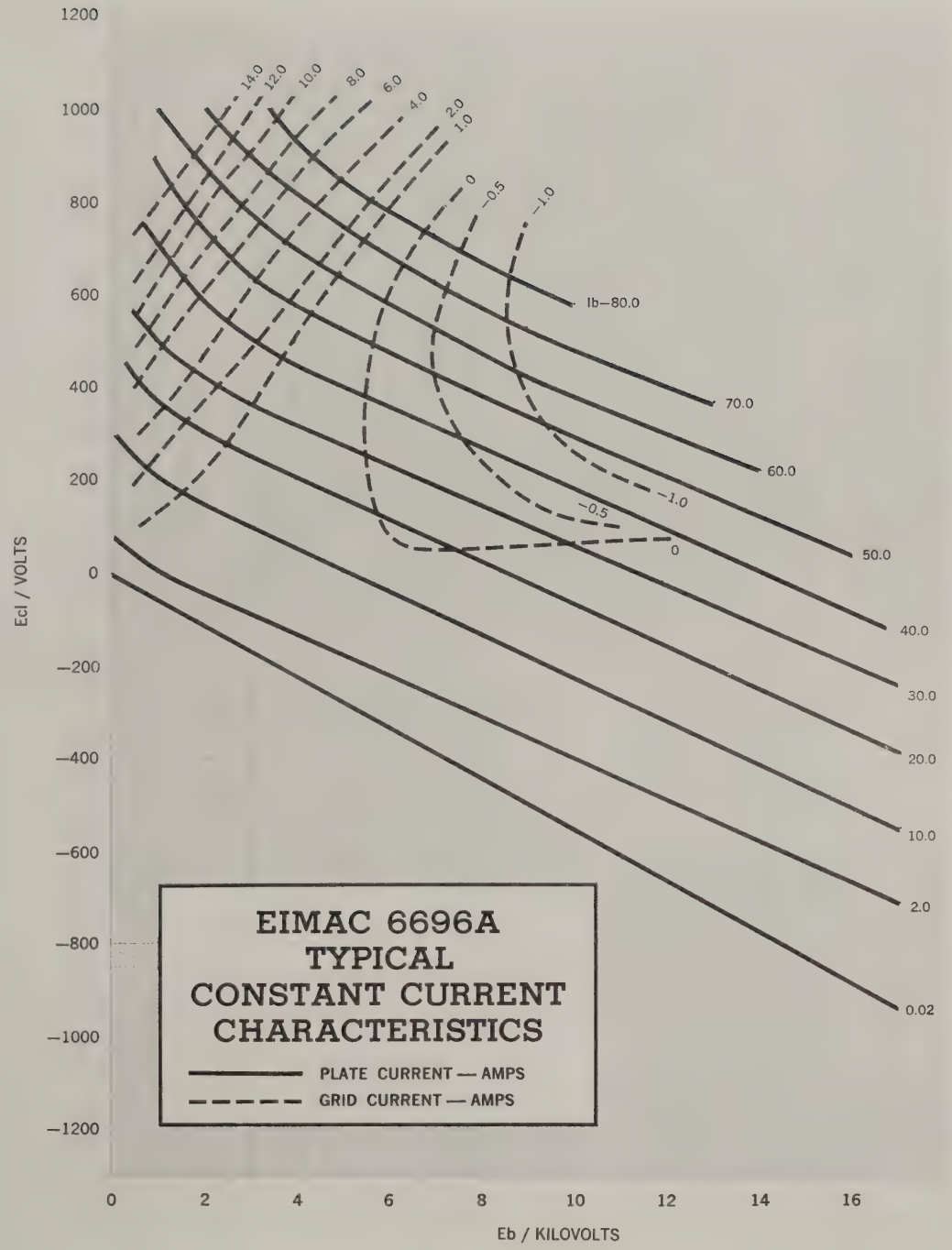
Tube Protection—

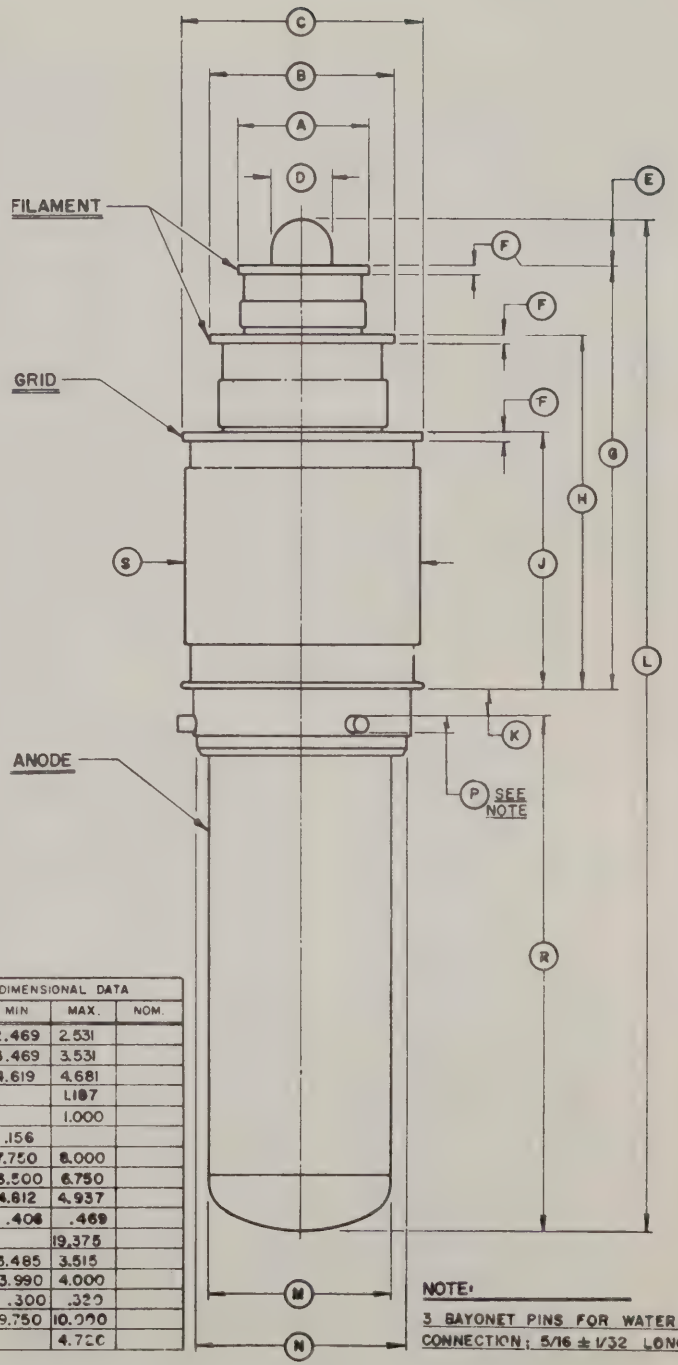
Since the possibility of fault overloads due to occasional tube or circuit instabilities is ever present, good engineering practice holds that suitable protective circuitry and devices be included in the equipment. In addition to the standard overcurrent relays, some series resistance should be placed in the output of the power supply to limit surge currents. In cases where no filter is used, the resistors may be placed in each rectifier lead to reduce the power loss during normal operation. In certain applications, furthermore, it is helpful to attach sphere gaps or rings to the tube terminals to divert any excessive transient voltages from the envelope and seals.

The use of an electronic fault diverter, or "crowbar" is probably the best way to insure high performance reliability and freedom from gassing or catastrophic failures. The crowbar system consists of circuitry to sense incipient fault currents and trigger the crowbar device, which is connected to short the power supply energy to ground, preferably within about 10 microseconds. The crowbar device, which is usually an ignitron, hydrogen thyratron, or spark gap, diverts most of the fault energy from the protected tube until the relay and circuit breakers open.

Special Applications—

If it is desired to operate this tube under conditions widely different from those given herein, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.





DIMENSIONAL DATA			
REF	MIN.	MAX.	NOM.
A	2.469	2.531	
B	3.469	3.531	
C	4.619	4.681	
D		LI87	
E		1.000	
F	.156		
G	7.750	8.000	
H	6.500	6.750	
J	4.812	4.937	
K	.406	.469	
L		19.375	
M	3.485	3.515	
N	3.990	4.000	
P	.300	.320	
R	9.750	10.000	
S		4.720	

NOTE:
3 BAYONET PINS FOR WATER JACKET CONNECTION; 5/16 ± 1/32 LONG

Eimac 6696A

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

6697A

FORCED-AIR COOLED MEDIUM-MU POWER TRIODE



The Eimac 6697A is a forced-air cooled ceramic-metal triode designed for AM broadcast and communications amplifiers and for industrial heating service.

Low-loss ceramic and metal construction permits operation at full ratings at frequencies up to 40 Mc. Useful power output can be obtained at frequencies up to 80 Mc at reduced plate voltage.

The 6697A anode is capable of dissipating 35 kilowatts. A water cooled version of this tube, type 6696A, and a vapor cooled version, type 7480, are also available.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.
Filament: Thoriated-Tungsten			
Voltage		13	volts
Current	190		220 amperes
Amplification Factor		20	
Direct Interelectrode Capacitances			
Grid-Plate	47		57 pf
Grid-Filament	65		85 pf
Plate-Filament	2.0		3.2 pf
Frequency for Maximum Ratings			40 Mc

MECHANICAL

Base	Coaxial
Operating Position	Vertical, base up
Cooling	Forced Air
Maximum Seal Temperature	200°C
Maximum Incoming Air Temperature	50°C
Maximum Height	19.9 inches
Maximum Diameter	5.28 inches
Net Weight	43 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	11 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	35 KW

TYPICAL OPERATION

DC Plate Voltage	10	15 kV
DC Grid Voltage	—1200	—1600 volts
Peak RF Grid Voltage	1900	2100 volts
DC Plate Current	10.0	7.0 amps
DC Grid Current	810	300 mA
Resonant Load Impedance	440	970 ohms
Driving Power, approx.	1500	600 watts
Plate Output Power, approx.	72	80 kW

(Effective 10-15-64) Copyright 1964 by Eitel-McCullough, Inc.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	8.5 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	23 KW

TYPICAL OPERATION

DC Plate Voltage	9.5 kV
DC Grid Voltage	—1600 volts
Peak RF Grid Voltage	2300 volts
DC Plate Current	8.4 amps
DC Grid Current	900 mA
Resonant Load Impedance	510 ohms
Driving Power, approx.	2.0 kW
Plate Output Power, approx.	60 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	35 KW

TYPICAL OPERATION (Two Tubes).

DC Plate Voltage	10 kV
DC Grid Voltage	—450 volts
Peak AF Driving Voltage (per tube)	875 volts
Zero-Sig DC Plate Current	3.0 amps
Max-Sig DC Plate Current	17.4 amps
Load Resistance, Plate-to-Plate	1170 ohms
Max-Sig Driving Power, app	550 watts
Max-Sig Plate Output Power approx.	110 kW

RADIO-FREQUENCY AM LINEAR AMPLIFIER

Class-AB (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	9.0 AMPS
PLATE DISSIPATION	35 KW

TYPICAL OPERATION (AM Carrier conditions except where noted).

DC Plate Voltage	12 kV
DC Grid Voltage	—550 volts
Peak RF Grid Voltage	510 volts
DC Plate Current	4.3 amps
DC Grid Current	0 amps
Resonant Load Impedance	780 ohms
Driving Power, approx.*	450 watts
Plate Output Power, approx.	18 kW

*At modulation crest.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB, Single-Sideband Suppressed-Carrier Service

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	35 KW

TYPICAL OPERATION (Peak-envelope or modulation-crest conditions in cathode-drive circuit).

DC Plate Voltage	12 kV
DC Cathode Voltage	600 volts
Peak RF Driving Voltage	830 volts
DC Plate Current	5.2 amps
DC Grid Current, approx.	60 mA
Resonant Load Impedance	880 ohms
Driving Power, approx.	3.5 kW
Plate Power Output, approx.	43 kW

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

MECHANICAL

Mounting—

The 6697A should be mounted vertically anode down in the air distributor (Machlett type F-17759 or equivalent). Filament and grid connections are made through clamp rings or spring-finger contacts to the O.D. of the sturdy copper terminals of the tube. Anode contact can be made to the top ring of the air distributor.

Anode Cooling—

Minimum cooling requirements are given in the accompanying table, based on a maximum incoming air temperature of 50°C at sea level.

MINIMUM ANODE COOLING REQUIREMENTS

Plate Dissipation kW	Air Flow Rate cfm	Pressure Drop inches water
10	240	0.2
20	700	1.5
30	1350	5.0
35	1700	8.0

Base Cooling—

Forced-air cooling of the ceramic base and seals may be required, depending on ambient conditions and operating frequency. Air flow rate and direction should be determined to limit envelope temperatures to 200°C maximum and to maintain uniform temperature distribution around the seals. Spot temperatures are conveniently measured with Tempilaq (spray type) or equivalent. Often the anode air supply can be deflected to cool the envelope and seals.

ELECTRICAL

Filament Operation—

The rated filament voltage, as measured at the tube terminals, should be maintained within ±5% to assure long life and good performance within the rated power capability of the tube. To accommodate special requirements, the filament voltage may be centered near either of these extremes, e.g. at plus 5 percent for exceptionally high emission at a sacrifice of life, or at minus 5 percent for exceptionally long life where perhaps only half the full emission capability is required.

Grid Dissipation—

Grid dissipation should be limited to 1,000 watts maximum. Grid dissipation may be calculated approximately as the product of peak positive grid voltage and dc grid current.

In many r-f amplifier applications where it is impractical to measure the positive grid voltage, the dc grid current rating serves as a satisfactory guide. The maximum dc grid current rating under normal full load conditions is 2 amperes. In most cases, however, high power output and good efficiency can be realized with grid current less than one ampere. By limiting the grid current in this manner there is obviously more latitude for grid current excursions resulting from changes in loading.

High Frequency Operation—

The maximum ratings listed apply at frequencies up to 40 Mc. Useful output can be obtained at higher frequencies if the plate voltage and plate input power are reduced accordingly. For operation up to 60 Mc these parameters should be reduced to 75% of the listed dc plate voltage rating; for operation up to 80 Mc they should be reduced to 50%.

Aging—

The manner of operating most high power tubes differs in at least some respects from conditions under which the tubes are tested, therefore, some aging is almost always required to condition a new tube to its new environment. In basic terms, the different operating conditions are manifest as different distributions of heat and voltage gradients. Satisfactory aging is most easily achieved by gradual application of voltages, e.g. first filament voltage, then partial plate voltage, and drive, working up to the final values. If continuous or stepped plate voltage control is not used, sufficient load should be connected before snapping on full voltage to limit transients to about 120% of the dc voltage.

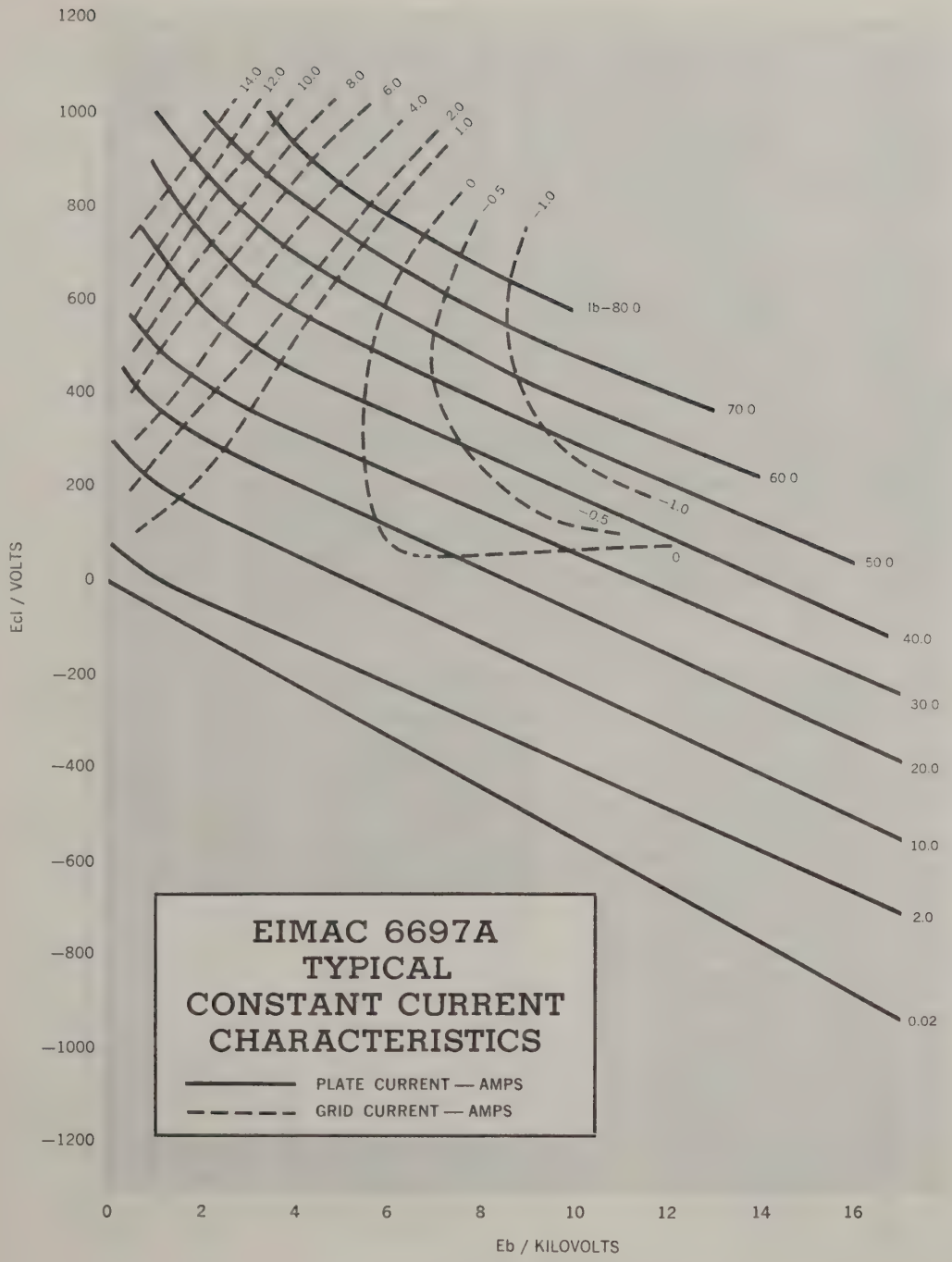
Tube Protection—

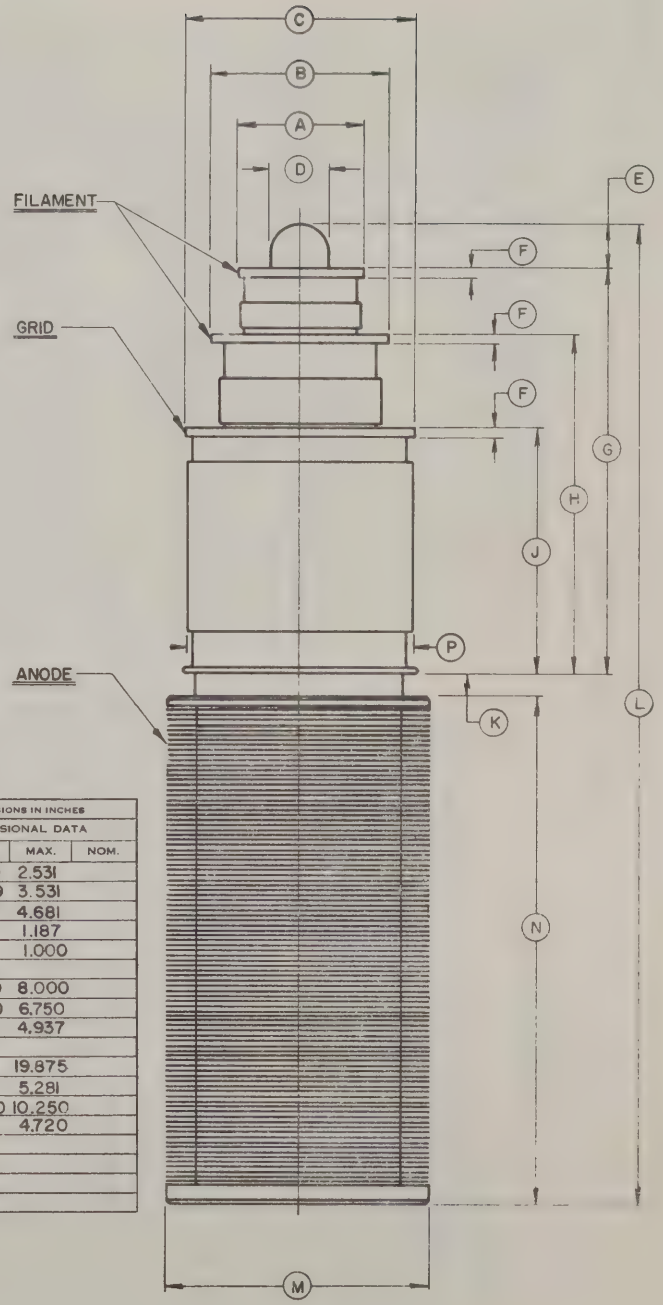
Since the possibility of fault overloads due to occasional tube or circuit instabilities is ever present, good engineering practice holds that suitable protective circuitry and devices be included in the equipment. In addition to the standard overcurrent relays, some series resistance should be placed in the output of the power supply to limit surge currents. In cases where no filter is used, the resistors may be placed in each rectifier lead to reduce the power loss during normal operation. In certain applications, furthermore, it is helpful to attach sphere gaps or rings to the tube terminals to divert any excessive transient voltages from the envelope and seals.

The use of an electronic fault diverter, or "crowbar" is probably the best way to insure high performance reliability and freedom from gassing or catastrophic failures. The crowbar system consists of circuitry to sense incipient fault currents and trigger the crowbar device, which is connected to short the power supply energy to ground, preferably within about 10 microseconds. The crowbar device, which is usually an ignitron, hydrogen thyratron, or spark gap, diverts most of the fault energy from the protected tube until the relay and circuit breakers open.

Special Applications—

If it is desired to operate this tube under conditions widely different from those given herein, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.





DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.469	2.531	
B	3.469	3.531	
C	4.619	4.681	
D		1.187	
E		1.000	
F	.156		
G	7.750	8.000	
H	6.500	6.750	
J	4.812	4.937	
K	.312		
L		19.875	
M	5.219	5.281	
N	10.000	10.250	
P		4.720	

7211

HIGH-MU UHF TRIODE



The Eimac 7211 is a ceramic-and-metal planar triode designed for use as a power amplifier, oscillator, or frequency multiplier in applications requiring greater power output than can be realized from the 7289/3CX100A5. Although similar in appearance, the Eimac 7211 incorporates a significantly improved and enlarged cathode which increases the power input capability to a maximum of 190 watts at frequencies to 2500 mc.

Exacting dimensional tolerances inherent in the manufacturing processes provide the Eimac 7211 with the maximum mechanical uniformity. Critical electrical testing results in increased reliability and a minimum variation in electrical characteristics.

GENERAL CHARACTERISTICS

Electrical

	Min.	Nom.	Max.
Cathode: Oxide-coated, Unipotential			
Heating time	60		seconds
Heater:			
Voltage		6.3	volts
Current	1.2		1.4 amperes
Amplification Factor		80	

Direct Interelectrode Capacitances	Min.	Max.
Grid-Cathode	7.0	9.0 uuf
Grid-Plate	2.1	2.4 uuf
Plate-Cathode		0.06 uuf
Frequency for Maximum Ratings		2500 mc

Mechanical

Terminals	Graduated Cylindrical Surfaces
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Anode Core	250°C
Operating Position	Any
Cooling	Conduction and Forced Air
Maximum Overall Dimensions:	
Length	2.701 inches
Diameter	1.264 inches
Net Weight	2.5 ounces
Shipping Weight	7.0 ounces

Radio Frequency Power Amplifier or Oscillator

MAXIMUM RATING (Per Tube)

DC PLATE VOLTAGE	1000 VOLTS MAX.
DC CATHODE CURRENT	0.190 AMP. MAX.
DC GRID VOLTAGE	—150 VOLTS MAX.
DC GRID CURRENT	0.045 AMP. MAX.
INSTANTANEOUS PEAK POSITIVE GRID VOLTAGE	30 VOLTS MAX.
INSTANTANEOUS PEAK NEGATIVE GRID VOLTAGE	—400 VOLTS MAX.
PLATE DISSIPATION	100 WATTS MAX.
GRID DISSIPATION	2 WATTS MAX.

TYPICAL OPERATION (Per Tube)	Power Amplifier Grounded-Grid (key-down conditions)	
	500 Mc	2500 Mc
DC PLATE VOLTAGE	900	900 Volts
DC GRID VOLTAGE (approx.)	—30	—20 Volts
DC PLATE CURRENT	140	140 Ma.
DC GRID CURRENT (approx.)	40	15 Ma.
DRIVING POWER (approx.)	9	- - Watts
USEFUL OUTPUT POWER	65	25 Watts

(Effective 9-1-64) Copyright 1964 by Eitel-McCullough, Inc.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	600 VOLTS MAX.
DC CATHODE CURRENT	0.140 AMP. MAX.
DC GRID VOLTAGE	—150 VOLTS MAX.
DC GRID CURRENT	0.050 AMP. MAX.
INSTANTANEOUS PEAK POSITIVE GRID VOLTAGE	30 VOLTS MAX.
INSTANTANEOUS PEAK NEGATIVE GRID VOLTAGE	—400 VOLTS MAX.
PLATE DISSIPATION	70 WATTS MAX.
GRID DISSIPATION	2 WATTS MAX.

TYPICAL OPERATION (Per Tube)
500 Mc, Grounded-Grid, Carrier Conditions.

DC PLATE VOLTAGE	600 Volts
DC GRID VOLTAGE (approx.)	—20 Volts
DC PLATE CURRENT	100 Milliamp.
DC GRID CURRENT (approx.)	35 Milliamp.
DRIVING POWER (approx.)	8 Watts
USEFUL CARRIER POWER OUTPUT	25 Watts

APPLICATION

MECHANICAL

Mounting —

The 7211 may be operated in any position. It should be firmly held in place by spring-finger collets bearing on the terminal surfaces. In use the tube should seat against the underside of the anode-terminal flange which is on the plane of reference for longitudinal dimensions. In applications involving severe shock and vibration, the tube may be clamped in place by applying a suitable clamping device to the anode-terminal flange. It is recommended that no other portion of the tube be subjected to clamping forces.

Connections —

The terminals are in the form of concentric cylinders of graduated diameters conveniently used with coaxial tuning devices. Spring-fingered collets should be used to make contact with the anode, grid, cathode and heater terminals. Adequate contact area and spring pressure should be provided to minimize heating and to prevent erratic circuit performance at the higher frequencies. Non-contacting or intermittently-contacting collet fingers will cause troublesome circuit behavior, especially at very-high and ultra-high frequencies. Electrode contact surfaces should be kept clean and free of oxide coatings.

Cooling —

Sufficient cooling air must be provided for the anode and body seals to maintain operating temperatures below the rated maximum value of 250° C.

At sea level, with an inlet air temperature of 20°C (68°F), 12.5 cubic feet per minute of air flow is required to cool the anode at 100 watts plate dissipation when the air cowling as illustrated is used. Operation at higher altitudes or with higher inlet temperatures requires increased volumes of flow to obtain equivalent cooling. When using the anode cowling as illustrated here, it is necessary to provide additional facilities for seal cooling.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness, regardless of the coolant type, flow rate or coolant temperature. One method of measuring the surface temperatures is the use of temperature sensitive lacquer, such as "Tempilaq."

ELECTRICAL

Heater Operation —

The rated heater voltage for the 7211 is 6.3 volts. The heater voltage for the 7211 should be maintained within plus or minus 5% of its intended value to minimize variations in circuit performance and to obtain maximum tube life.

At frequencies above approximately 1000 megacycles, transit time effects begin to influence cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, driving power, and duty factor. If the conditions of operation result in appreciable cathode back-heating, it may be necessary to start dynamic tube operation at normal heater voltage followed by a reduction of heater voltage to a lower value.

Cathode Operation —

The oxide-coated unipotential cathode in this tube must be protected against excessively high emission currents. For all types of operation the maximum rated dc current is 190 milliamperes.

It is recommended that the rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied.

Control Grid Operation —

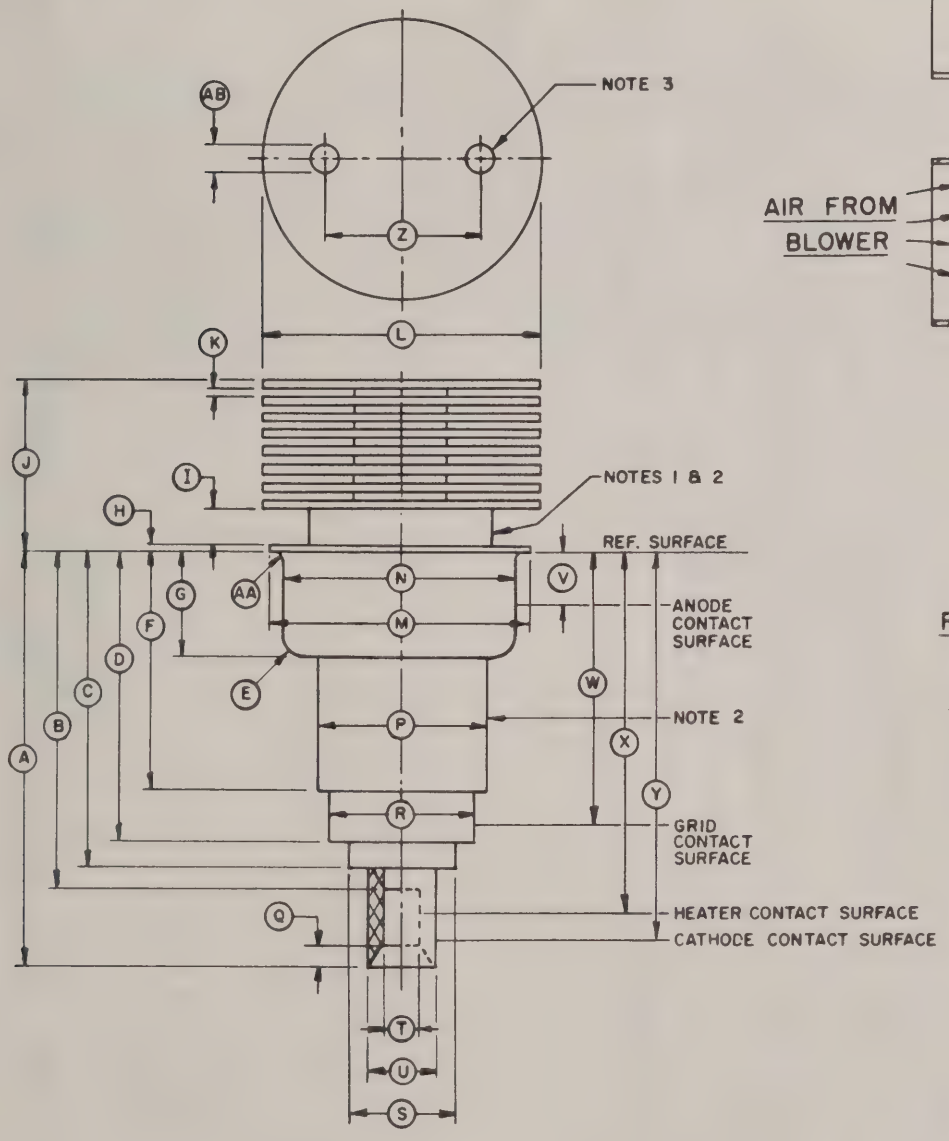
Grid dissipation must not exceed the rated maximum 2.0 watts grid dissipation power. In pulse applications the instantaneous peak grid-to-cathode voltage must be limited to —250 to —750 volts.

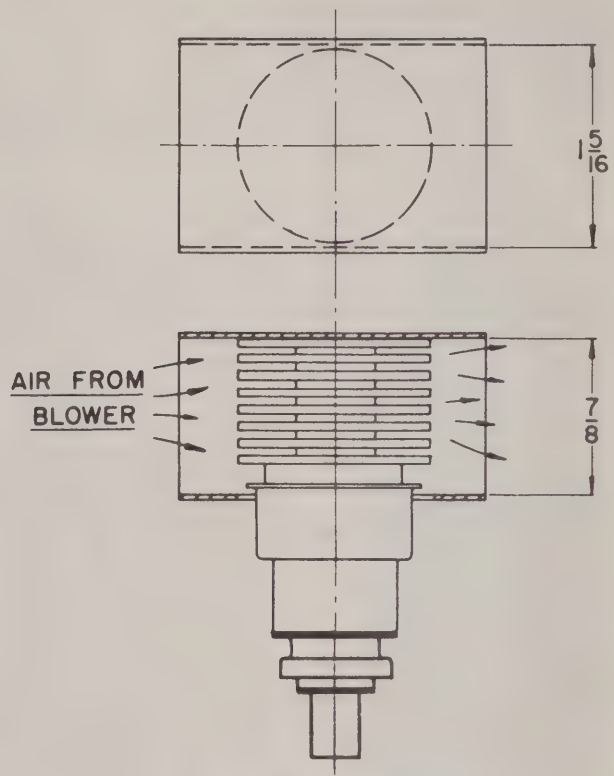
Special Applications —

If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

NOTES:

1. MEASURE ANODE SHANK TEMPERATURE ON THIS SURFACE.
2. DO NOT CLAMP OR LOCATE ON THIS SURFACE.
3. HOLE PROVIDED FOR TUBE EXTRACTOR THROUGH TOP FIN ONLY.





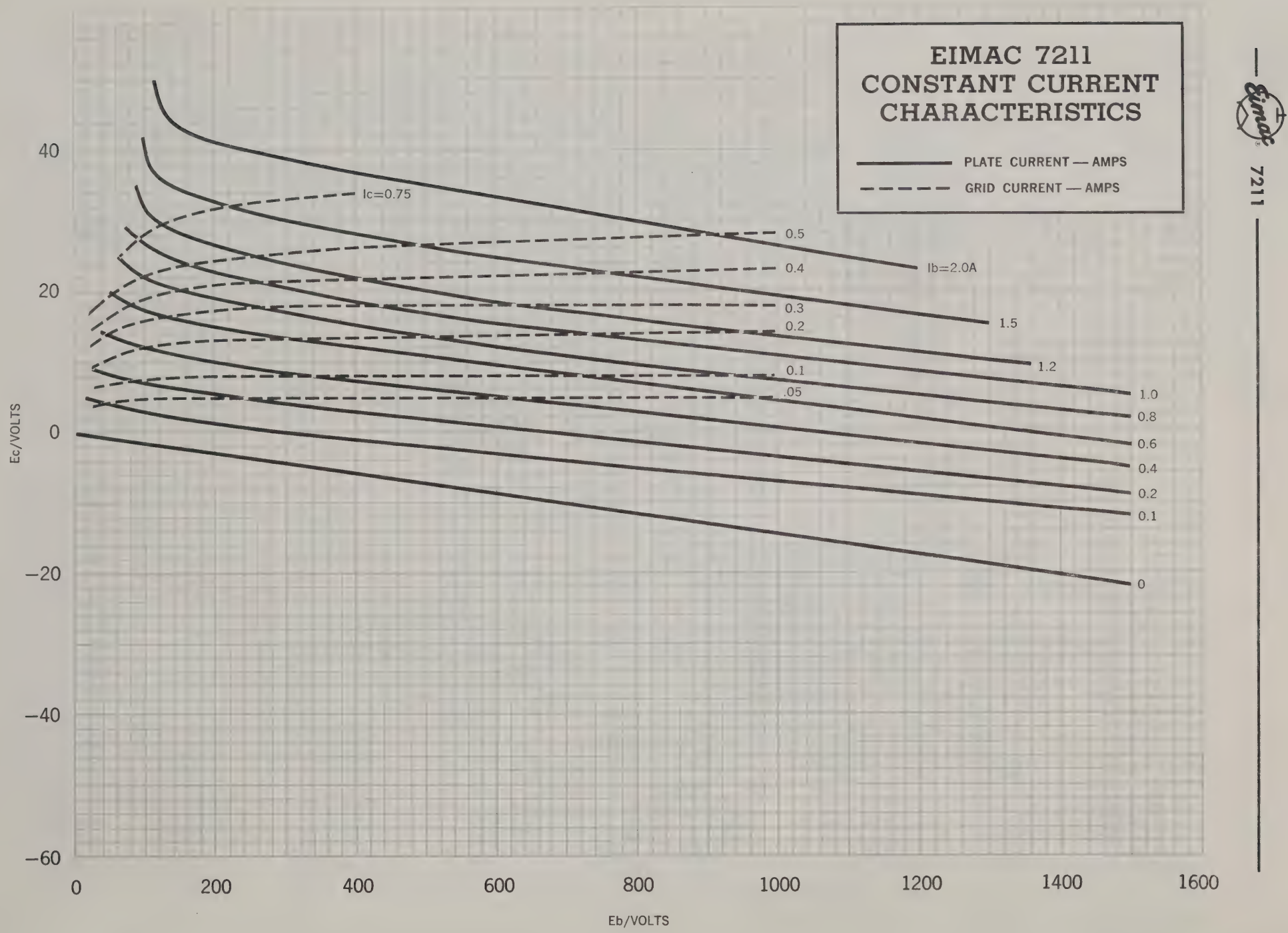
RECOMMENDED COWLING FOR FORCED-AIR COOLING OF ANODE

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.815	1.875	
B		1.534	
C		1.475	
D	1.289	1.329	
E		.100	
F	.970	1.010	
G	.462	.477	
H		.040	
I	.125	.185	
J	.766	826	
K	.025	.046	
L	1.234	1.264	
M	1.180	1.195	
N	1.025	1.035	
P	.772	792	
Q		086	
R	.655	.665	
S		.545	
T	213	.223	
U	.315	.325	
Z	.650	.850	
AA		.035	
AB	.105	.145	

NOTES:

1. The total indicated runout of the anode contact surface and the grid contact surface with respect to the cathode contact surface shall not exceed .020.

2. The total indicated runout of the heater contact surface with respect to the cathode contact surface shall not exceed .012.


EIMAC 7211
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPS
GRID CURRENT — AMPS
Ic=0.75
0.5
0.4
0.3
0.2
0.1
.05
Ib=2.0A
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.1
0
40
20
0
−20
−40
−60
Ec/VOLTS
0
200
400
600
800
1000
1200
1400
1600
Eb/VOLTS

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

7480

VAPOR COOLED MEDIUM-MU POWER TRIODE



The Eimac 7480 is a vapor cooled ceramic-metal triode designed for for AM broadcast and communications amplifiers and for industrial heating service.

Low-loss ceramic and metal construction permits operation at full ratings at frequencies up to 40 Mc. Useful power output can be obtained at frequencies up to 80 Mc at reduced plate voltage.

The 7480 anode is capable of dissipating 80 kilowatts continuously, and higher power during intermittent operation or momentary overloads. A water cooled version of this tube, type 6696A, and a forced-air cooled version, type 6697A, are also available.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.
Filament: Thoriated-Tungsten			
Voltage		13	volts
Current	190		220 amperes
Amplification Factor		20	
Direct Interelectrode Capacitances			
Grid-Plate	50		60 pf
Grid-Filament	65		85 pf
Plate-Filament	2.0		3.2 pf
Frequency for Maximum Ratings			40 Mc

MECHANICAL

Base	Coaxial
Operating Position	Vertical, base up
Cooling	Vaporization of water
Maximum Seal Temperature	200°C
Recommended Boiler	Eimac BR-400 Series or equivalent
Maximum Height	20.1 inches
Maximum Diameter	7.12 inches
Net Weight	50 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	11 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	80 KW

TYPICAL OPERATION

DC Plate Voltage	10	15 kV
DC Grid Voltage	—1200	—1600 volts
Peak RF Grid Voltage	1900	2100 volts
DC Plate Current	10.0	7.0 amps
DC Grid Current	810	300 mA
Resonant Load Impedance	440	970 ohms
Driving Power, approx.	1500	600 watts
Plate Output Power, approx.	72	80 kW

(Effective 10-15-64) Copyright 1964 by Eitel-McCullough, Inc.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10.0 KV
DC GRID VOLTAGE	—3200 VOLTS
DC PLATE CURRENT	8.5 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	53 KW

TYPICAL OPERATION

DC Plate Voltage	9.5 kV
DC Grid Voltage	—1600 volts
Peak RF Grid Voltage	2300 volts
DC Plate Current	8.4 amps
DC Grid Current	900 mA
Resonant Load Impedance	510 ohms
Driving Power, approx.	2.0 kW
Plate Output Power, approx.	60 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	80 KW

TYPICAL OPERATION (Two Tubes).

DC Plate Voltage	10	12 kV
DC Grid Voltage	—450	—600 volts
Peak AF Driving Voltage (per tube)	875	1060 volts
Zero-Sig DC Plate Current	3.0	2.0 amps
Max-Sig DC Plate Current	17.4	20.0 amps
Load Resistance, Plate-to-Plate	1170	1230 ohms
Max-Sig Driving Power, approx.	550	600 watts
Max-Sig Plate Output Power, approx.	110	152 kW

RADIO-FREQUENCY AM LINEAR AMPLIFIER

Class-AB (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	9.0 AMPS
PLATE DISSIPATION	80 KW

TYPICAL OPERATION (AM Carrier conditions except where noted).

DC Plate Voltage	12	12 kV
DC Grid Voltage	—550	—550 volts
Peak RF Grid Voltage	510	640 volts
DC Plate Current	4.3	6.8 amps
DC Grid Current	0	0 amps
Resonant Load Impedance	780	500 ohms
Driving Power, approx.*	450	1500 watts
Plate Output Power, approx.	18	28 kW

*At modulation crest.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB, Single-Sideband Suppressed-Carrier Service

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	80 KW

TYPICAL OPERATION (Peak-envelope or modulation-crest conditions in cathode-drive circuit).

DC Plate Voltage	12	12 kV
DC Cathode Voltage	600	600 volts
Peak RF Driving Voltage	830	1020 volts
DC Plate Current	5.2	9.8 amps
DC Grid Current, approx.	60	200 mA
Resonant Load Impedance	880	700 ohms
Driving Power, approx.	3.5	8.2 kW
Plate Power Output, approx.	43	83 kW

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

MECHANICAL

Mounting—

The 7480 should be mounted vertically anode down in the boiler (Eimac type BR-400 or equivalent). Filament and grid connections are made through clamp rings or spring-finger contacts to the O.D. of the sturdy copper terminals of the tube. Satisfactory anode contact can be made to the boiler.

Anode Cooling—

Efficient cooling is accomplished by vaporization of water in the boiler and transport of the vapor to a condenser at a temperature of about 100°C. The *boiler*, which is at anode potential, is isolated electrically from the rest of the system by sections of insulating pipe in the vapor and condensate return lines. The *control box*, connected across the boiler on the ground side of the insulating tubes, displays the water level in the boiler, actuates warning or interlock circuits if the level is too low, and permits overflow if the level is too high. A *reservoir* is usually associated with the control box, either integral or remote, to replenish the system with distilled water as required.

Application information and typical system layout drawings are available from Eitel-McCullough, Inc. All accessory components and special hardware is available from Eimac except condensers, for which commercial sources exist.

Base Cooling—

Forced-air cooling of the ceramic base and seals may be required, depending on ambient conditions and operating frequency. Air flow rate and direction should be determined to limit envelope temperatures to 200°C maximum and to maintain uniform temperature distribution around the seals. Spot temperatures are conveniently measured with Tempilaq (spray type) or equivalent. Often a flow of about 100 cfm, directed axially downward towards the tube, is sufficient.

ELECTRICAL

Filament Operation—

The rated filament voltage, as measured at the tube terminals, should be maintained within ±5% to assure long life and good performance within the rated power capability of the tube. To accommodate special requirements, the filament voltage may be centered near either of these extremes, e.g. at plus 5 percent for exceptionally high emission at a sacrifice of life, or at minus 5 percent for exceptionally long life where perhaps only half the full emission capability is required.

Grid Dissipation—

Grid dissipation should be limited to 1,000 watts maximum. Grid dissipation may be calculated approximately as the product of peak positive grid voltage and dc grid current.

In many r-f amplifier applications where it is impractical to measure the positive grid voltage, the dc grid current rating serves as a satisfactory guide. The maximum dc grid current rating under normal full load conditions is 2 amperes. In most cases, however, high power output and good efficiency can be realized with grid current less than one ampere. By limiting the grid current in this manner there is obviously more latitude for grid current excursions resulting from changes in loading.

High Frequency Operation—

The maximum ratings listed apply at frequencies up to 40 Mc. Useful output can be obtained at higher frequencies if the plate voltage and plate input power are reduced accordingly. For operation up to 60 Mc these parameters should be reduced to 75% of the listed dc plate voltage rating; for operation up to 80 Mc they should be reduced to 50%.

Aging—

The manner of operating most high power tubes differs in at least some respects from conditions under which the tubes are tested, therefore, some aging is almost always required to condition a new tube to its new environment. In basic terms, the different operating conditions are manifest as different distributions of heat and voltage gradients. Satisfactory aging is most easily achieved by gradual application of voltages, e.g. first filament voltage, then partial plate voltage, and drive, working up to the final values. If continuous or stepped plate voltage control is not used, sufficient load should be connected before snapping on full voltage to limit transients to about 120% of the dc voltage.

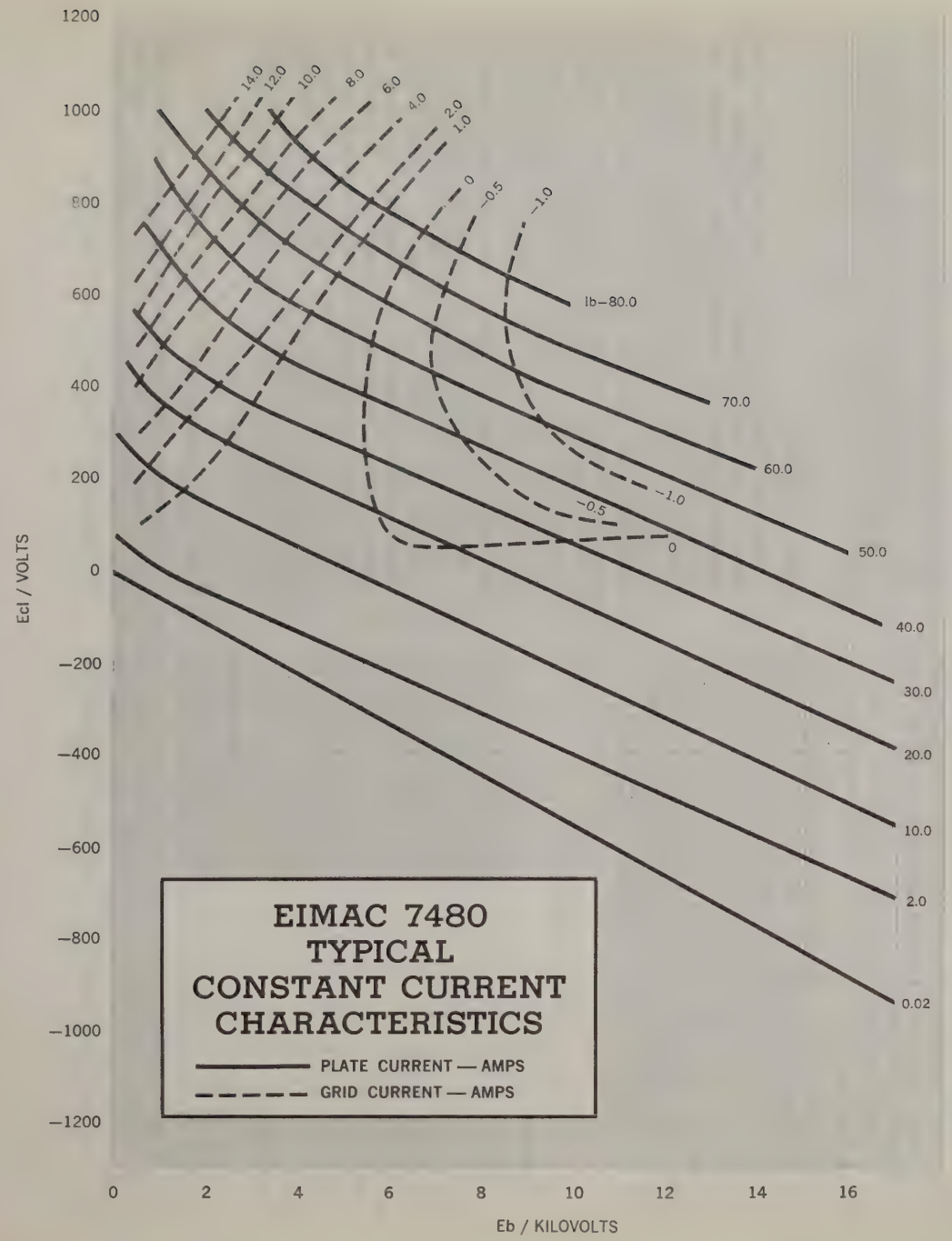
Tube Protection—

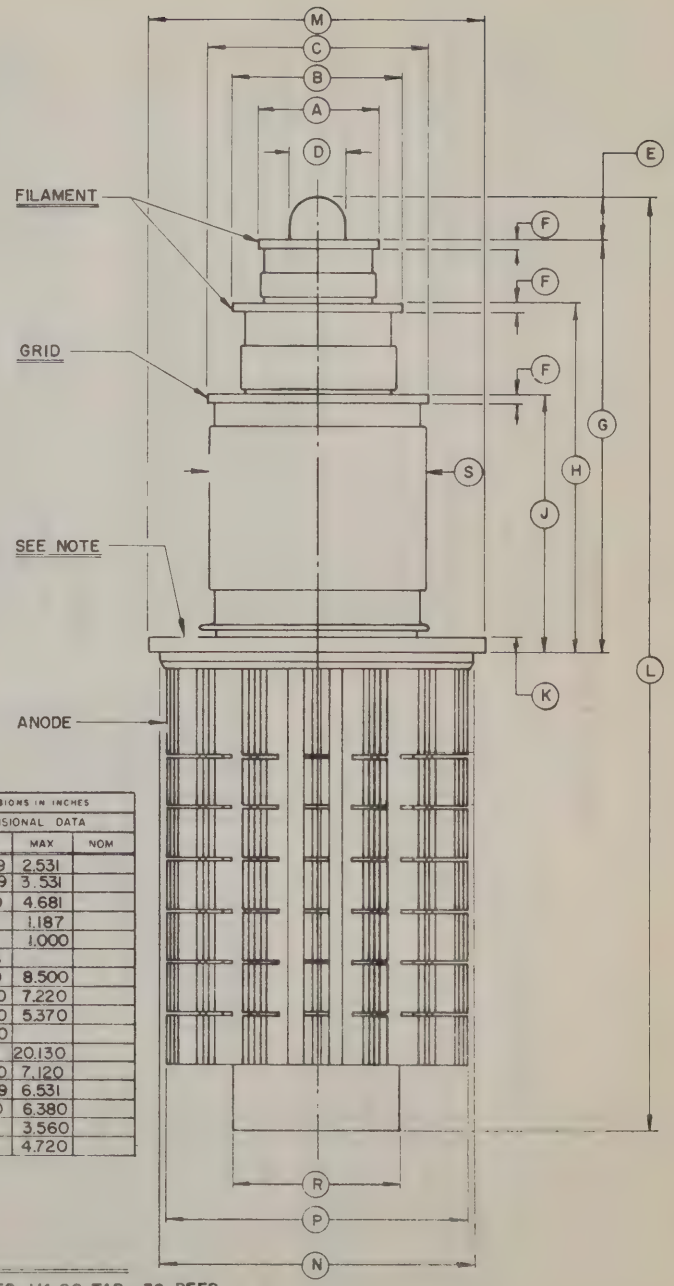
Since the possibility of fault overloads due to occasional tube or circuit instabilities is ever present, good engineering practice holds that suitable protective circuitry and devices be included in the equipment. In addition to the standard overcurrent relays, some series resistance should be placed in the output of the power supply to limit surge currents. In cases where no filter is used, the resistors may be placed in each rectifier lead to reduce the power loss during normal operation. In certain applications, furthermore, it is helpful to attach sphere gaps or rings to the tube terminals to divert any excessive transient voltages from the envelope and seals.

The use of an electronic fault diverter, or "crowbar" is probably the best way to insure high performance reliability and freedom from gassing or catastrophic failures. The crowbar system consists of circuitry to sense incipient fault currents and trigger the crowbar device, which is connected to short the power supply energy to ground, preferably within about 10 microseconds. The crowbar device, which is usually an ignitron, hydrogen thyratron, or spark gap, diverts most of the fault energy from the protected tube until the relay and circuit breakers open.

Special Applications—

If it is desired to operate this tube under conditions widely different from those given herein, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF	MIN	MAX	NOM
A	2.469	2.531	
B	3.469	3.531	
C	4.619	4.681	
D		1.187	
E		1.000	
F	.156		
G	8.120	8.500	
H	6.900	7.220	
J	5.250	5.370	
K	.250		
L		20.130	
M	7.000	7.120	
N	6.469	6.531	
P	6.120	6.380	
R		3.560	
S		4.720	

NOTE:

3 HOLES, 1/4-20 TAP, .38 DEEP EQUALLY SPACED ON 5.740-5.760 POINT CIRCLE; FOR LIFTING.

8170
4CX5000A

RADIAL-BEAM POWER TETRODE



The Eimac 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megacycles and is particularly suited for use as a linear single-sideband amplified, class-AB$_1$ audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for class-AB operation.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)		4.5		
▶ Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	uuf
Output	18		23	uuf
Feedback			1.0	uuf

▶ Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	48	58	uuf
Output	18	23	uuf
Feedback		0.16	uuf

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250° C
Maximum Anode-Core Temperature	250° C
Recommended Socket	Eimac SK-300A
Recommended Chimney	Eimac SK-306
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.13 inches
Diameter	4.94 inches
Cooling	Forced air
Net Weight	9.5 pounds
Shipping Weight (Approximate)	22 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megacycles)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	—350 volts
D-C Plate Current	2.8 amperes
D-C Screen Current	0.5 ampere
D-C Grid Current	0.25 ampere
Peak R-F Grid Voltage	590 volts
Driving Power	150 watts
Plate Dissipation	5000 watts
Plate Output Power	16,000 watts

▶ Indicates change from sheet dated 3-15-60

(Effective 10-1-64) © 1956-1961-1963 by Eitel-McCullough, Inc.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR (From 30 to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
30 to 60 megacycles	7000 MAX. VOLTS
60 to 110 megacycles	6500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT:	
30 to 60 megacycles	2.8 MAX. AMPERES
60 to 110 megacycles	2.6 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies between 88 and 108 megacycles)

D-C Plate Voltage	6500	volts
D-C Screen Voltage	750	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.3	amperes
D-C Screen Current	0.2	ampere
D-C Grid Current	0.05	ampere
Driving Power	25	watts
Useful Output Power	10,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	450	volts
D-C Grid Voltage	—400	volts
D-C Plate Current	1.4	amperes
D-C Screen Current	0.26	ampere
D-C Grid Current	0.05	ampere
Peak R-F Grid Voltage	520	volts
Grid Driving Power	25	watts
Plate Dissipation	1100	watts
Plate Output Power	5.8	kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

(Carrier conditions except where noted)

MAXIMUM RATINGS, Class-C Telephony (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 megacycles, per tube)

D-C Plate Voltage	7500	7500	volts
D-C Screen Voltage	350	350	volts
Peak A-F Screen Voltage (For 100-percent modulation)	550	550	volts
D-C Grid Voltage	—300	—300	volts
D-C Plate Current	0.9	1.14	amperes
D-C Screen Current*	—0.01	—0.01	ampere
D-C Grid Current	0.015	0.03	ampere
Peak R-F Grid Voltage	350	375	volts
Grid Driving Power	7	11	watts
R-F Load Impedance	2000	1600	ohms
Plate Dissipation	4000	5000	watts
Useful Output Power	2750	3550	watts

*D-C Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7000	volts
D-C Screen Voltage	1250	1250	1250	1250	volts
D-C Grid Voltage	—270	—280	—310	—325	volts
Max.-Signal Plate Current	5.10	4.40	4.25	3.65	amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24	ampere
Zero-Signal Screen Current	0	0	0	0	amperes
Peak A-F Driving Voltage	250	240	270	235	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100	ohms
Max.-Signal Plate Dissipation	4200	4200	4200	4200	watts
Max.-Signal Plate Output Power	11,500	13,500	17,000	17,500	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1250	volts
D-C Grid Voltage*	—300	volts
Max.-Signal Plate Current	1.9	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	0.20	ampere
Peak R-F Grid Voltage	300	volts
Driving Power	0	watts
Plate Dissipation	4200	watts
Plate Output Power**	10,000	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting—The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5OOOA. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

Cooling—The maximum temperature rating for the external surfaces of the 4CX5000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SK-300A Socket		SK-300 Socket	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

*Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation— The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

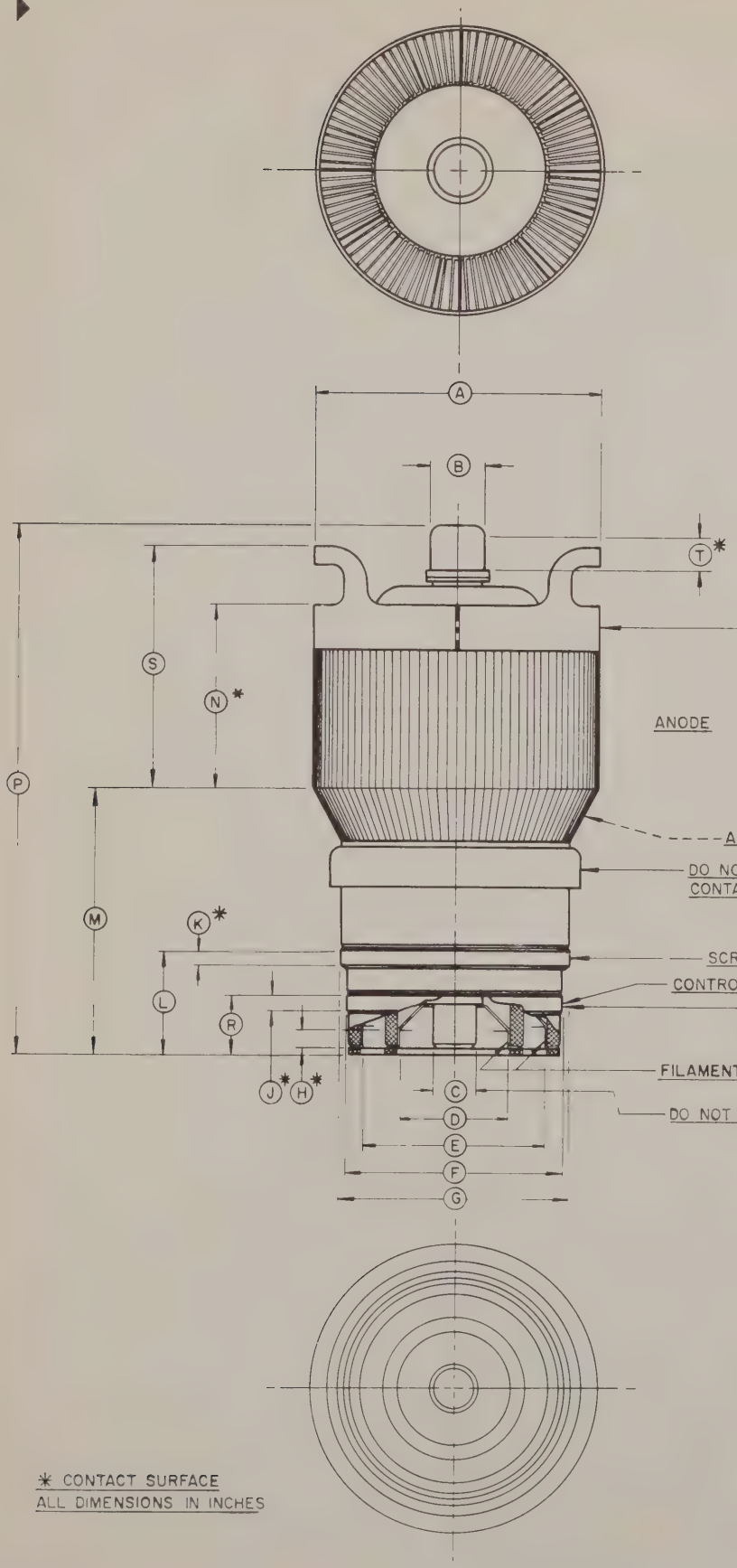
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

When the 4CX5000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

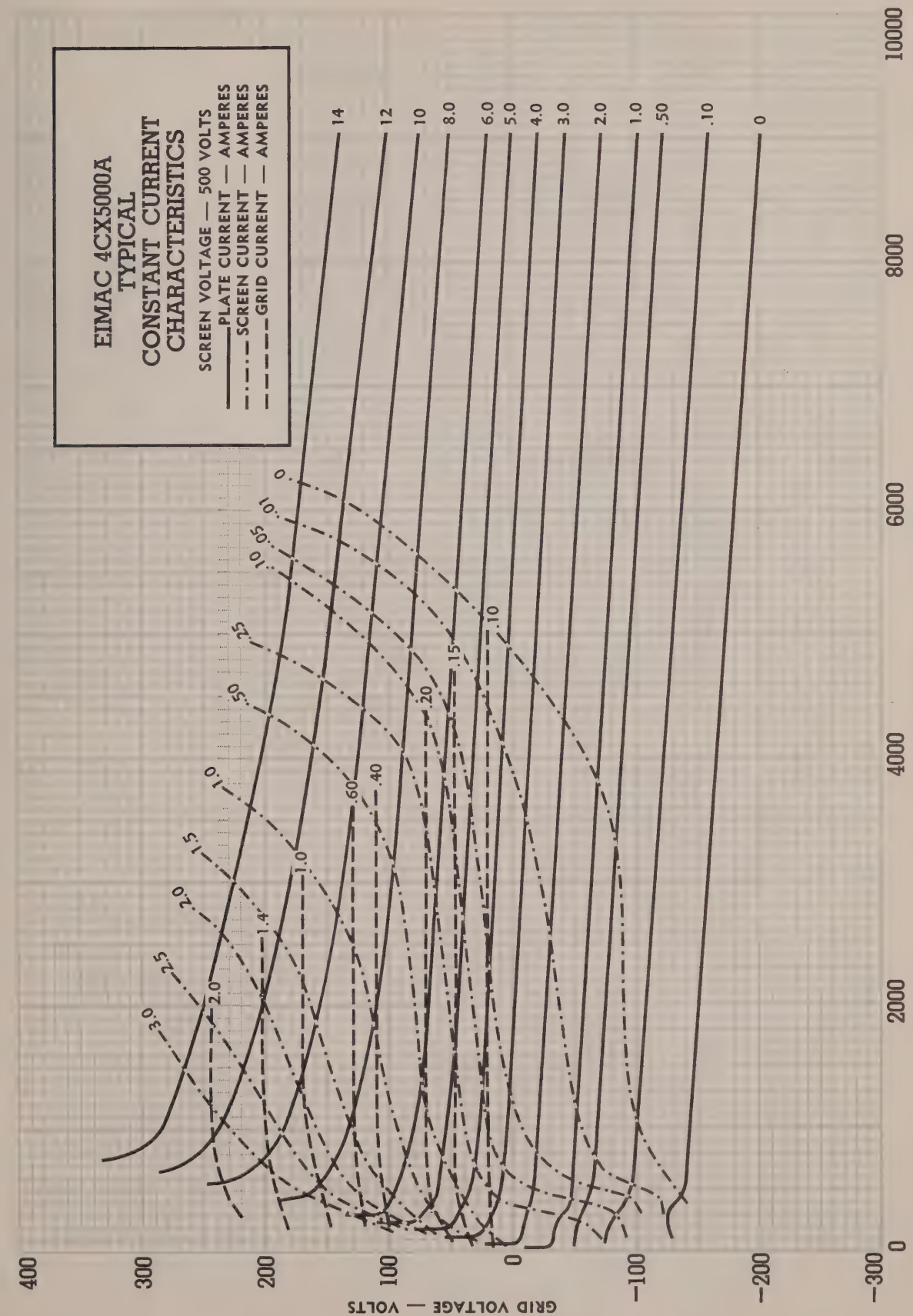
Indicates change from sheet dated 3-15-60

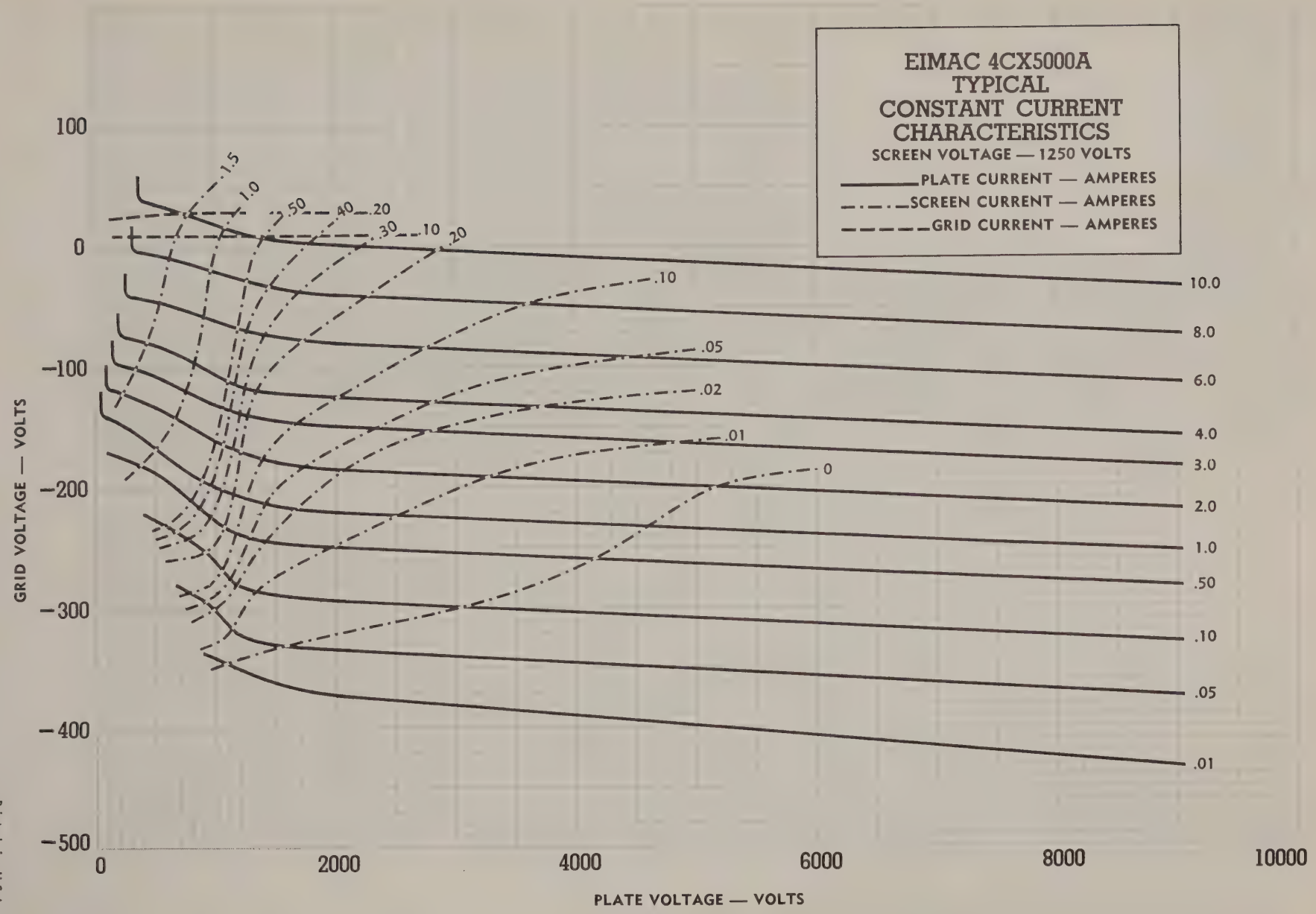


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4.812	4.938
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.188	4.563
N		2.875	3.250
P		8.625	9.125
R		.986	1.050
S		3.875	4.250
T		.375	

* CONTACT SURFACE
ALL DIMENSIONS IN INCHES

▶ Indicates change from sheet dated 3-15-60


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0
GRID VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
PLATE VOLTAGE — VOLTS
0
2000
4000
6000
8000
10000



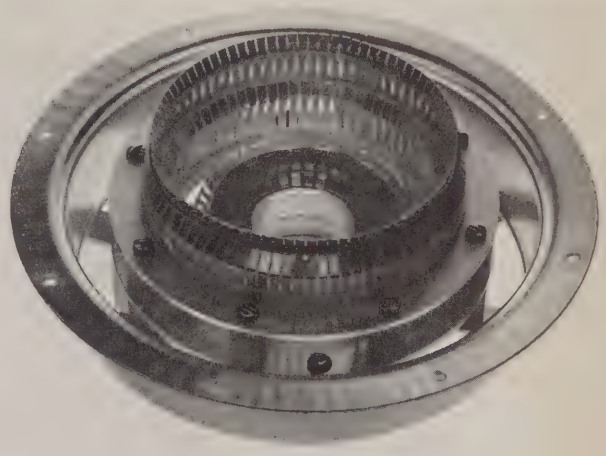
Printed in U.S.A. 5415

Eimac

EITEL-McCULLOUGH, INC.

SK-300A
AIR-SYSTEM SOCKET

The Eimac SK-300A Air-System Socket is recommended for use with those tube types listed at the bottom of the data sheet. The Eimac SK-306, SK-316 and SK-1306 Air Chimneys are available for use with this socket. When this socket is used, connection is made to each of the tube electrodes, except the anode, by means of concentric rings of spring-finger contacts. The SK-300A is an improved version of the SK-300 with significantly reduced pressure drop at the air-flow rates used with these tubes. The cooling air horsepower requirements are appreciably lower for these tube types in an SK-300A as compared to the SK-300.



BASE CONNECTION

The SK-300A Air-System Socket consists of four concentric rings of spring-finger contacts. The socket is provided with two filament connectors with a ¼" diameter hole in each connector for making connection to the inner and outer filament contacts, one 6-32 terminal is provided for DC connection to the screen-grid. RF connection to the screen-grid may be made directly to the collet. The SK-300A has four 8-32 terminals for connecting to the control-grid. The four contact rings are shown on the outline drawing.

ENVIRONMENTAL

HUMIDITY:	MIL-STD-202B, Method 103A, Test Condition "B"	
SHOCK:	MIL-STD-202B, Method 205B, Test Condition "B"	
VIBRATION:	MIL-STD-167, Type I, 5-33 CPS	
SALT SPRAY:	MIL-STD-202B, Method 101A, Test Condition "B"	
OPERATING TEMPERATURE: 125°C		
MAXIMUM WORKING VOLTAGE:	Screen-Grid	3000 Vdc
	Control-Grid	3000 Vdc

MATERIALS AND FINISHES

The socket body is made from brass silver-plated. The contact material is a non-ferrous spring alloy, Beryllium-copper, per QQ-C-533, heat treated for spring action and silver-plated, per QQ-S-365, for good RF conductivity. The insulation material is Teflon and Rexolite.

INSTALLATION

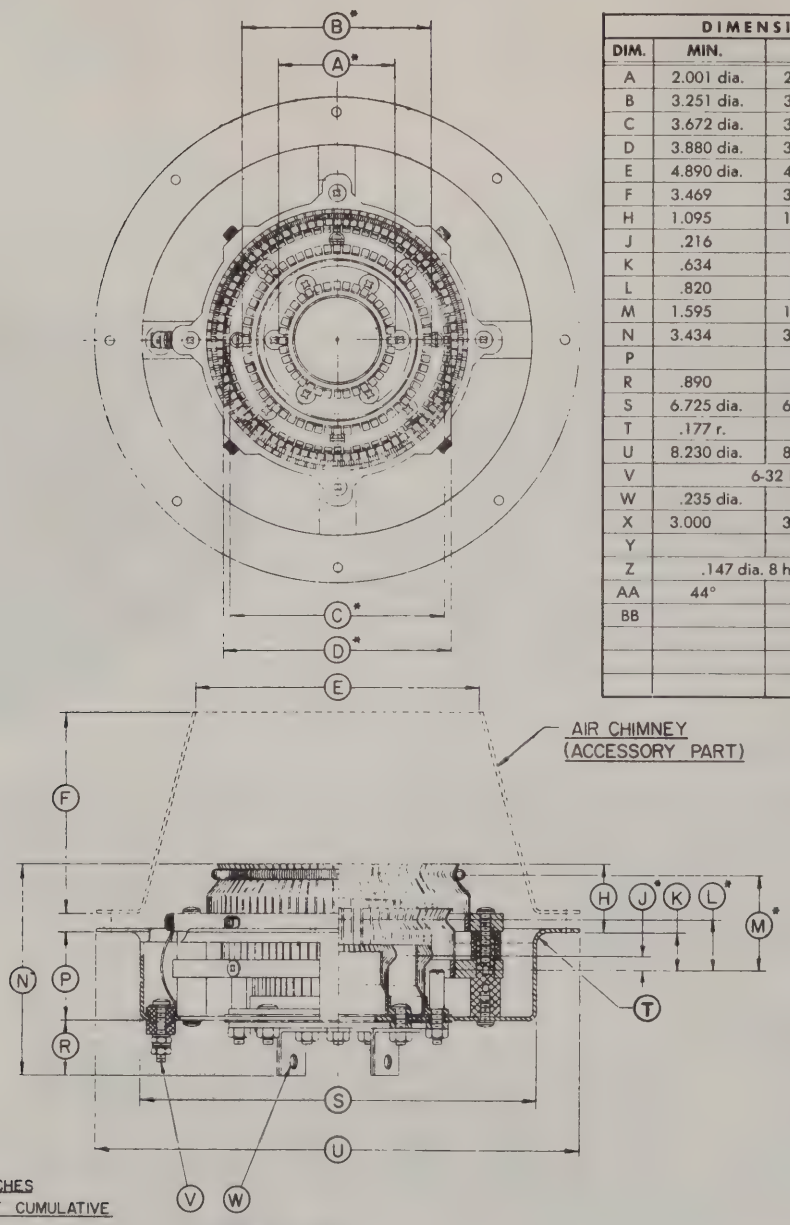
The SK-300A Air-System Socket can be mounted on a chassis deck, partition or pressurized compartment. Chassis mounting is accomplished by cutting a 7-3/16" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by eight 6-32 machine screws through the eight holes provided for fastening. The SK-300A Air-System Socket is recommended for use with the following tubes:

8170/4CX5000A	8171/4CX10,000D
8170W/4CX5000R	8281/4CX15,000A
4CW10,000A	

NET WEIGHT - - - - - - - - - - - - - - - SK-300A 3.25 Lbs.

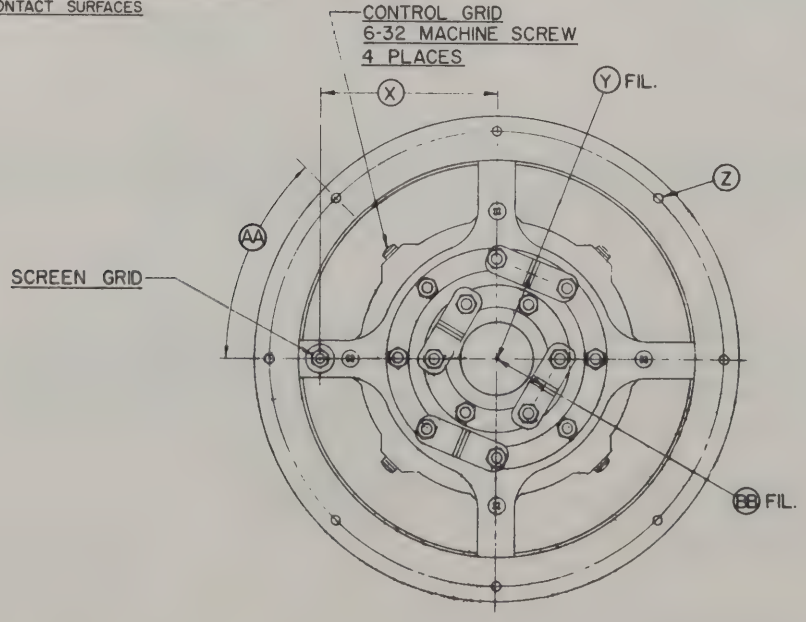
(Effective 11-1-64) © Copyright 1964 by Eitel-McCullough, Inc.

DIMENSION DATA			
DIM.	MIN.	MAX.	REF
A	2.001 dia.	2.061 dia.	
B	3.251 dia.	3.311 dia.	
C	3.672 dia.	3.732 dia.	
D	3.880 dia.	3.940 dia.	
E	4.890 dia.	4.921 dia.	
F	3.469	3.531	
H	1.095	1.140	
J	.216	.240	
K	.634	.689	
L	.820	.856	
M	1.595	1.657	
N	3.434	3.581	
P			1.500
R	.890	.940	
S	6.725 dia.	6.766 dia.	
T	.177 r.	.187 r.	
U	8.230 dia.	8.266 dia.	
V	6-32 NC-2A STUD		
W	.235 dia.	.265 dia.	
X	3.000	3.030	
Y			1.575
Z	.147 dia. 8 holes on 7¾ dia. p.c.		
AA	44°	46°	
BB			.950



NOTES

1. ALL DIMENSIONS IN INCHES
2. TOLERANCES ARE NOT CUMULATIVE
3. * CONTACT SURFACES



Eimac®

VacCap

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

CERAMIC VacCap* VACUUM CAPACITORS



When Eitel-McCullough introduced the vacuum capacitor into the United States in June of 1938, the device incorporated a series of concentric rings of varying diameter. This configuration, now "universal" for vacuum capacitors, worked well with transmitter designs of that era. However, today's advanced transmitter designs demand considerably increased power and current ratings, sometimes beyond the capability of ring-into-ring capacitors.

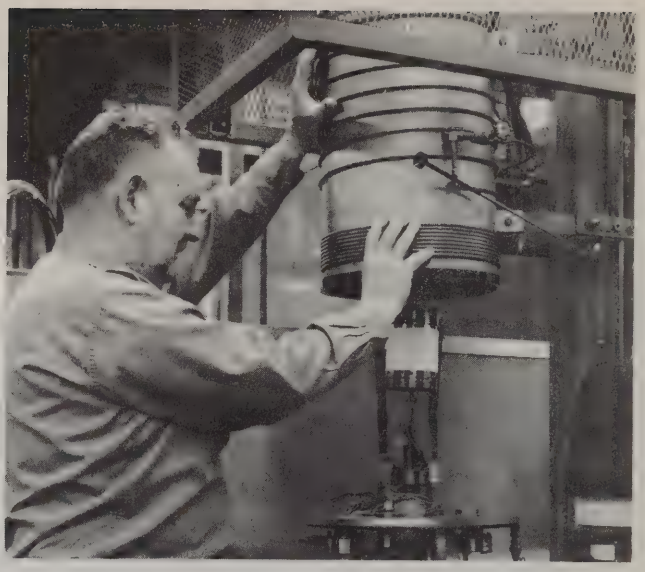
Eimac VacCap* vacuum capacitors take into account these modern requirements through a unique patented design which results in higher rf rms current ratings. The old concentric-ring design has been replaced by a group of thick-walled sections of copper tubing, brazed to a heavy end-bell. Smaller diameter copper tubes, brazed to an end-bell at the opposite end of the capacitor, work into the larger tubes. This configuration provides for very effective heat dissipation. With the new design, each section of tubing has its own individual rf path to the end-bell, whereas ring-into-ring designs require that the rf current flow up one ring wall, down the other side, up the next ring wall, down again, and so on. The tube-into-tube design is used on both fixed and variable VacCap* vacuum capacitors, along with newly-designed copper bellows. All-copper-and-ceramic construction permits higher bakeout temperatures to be used during manufacture of the capacitors, and assures an improved vacuum for higher reliability and longer life.

(Effective 2-15-65) © Eitel-McCullough, Inc. 1965

*Trademark



Final Assembly of VacCap* Variable Vacuum Capacitor



Fixed VacCap* Vacuum Capacitor in High Temperature Differential Pump System

ESTABLISHMENT OF RATINGS

All maximum peak-voltage ratings on the following data sheets are for 60-cycle alternating current. All maximum rms current ratings were established at a radio frequency of 16 Mc, with a uniform end-bell and connecting-strap temperature of 100°C. Measurements were made using radiation and convection cooling only. No other cooling was employed in establishing these ratings.

Higher voltage and current ratings than those listed on the following data sheets are available on special order. Heat sink, forced-air, or water cooling may be used.

Our application engineers will be pleased to make tests in our laboratory under your specific conditions. Requests for application engineering assistance or further information should be addressed to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, Attn: Application Engineering, Power Grid Tube Divison.

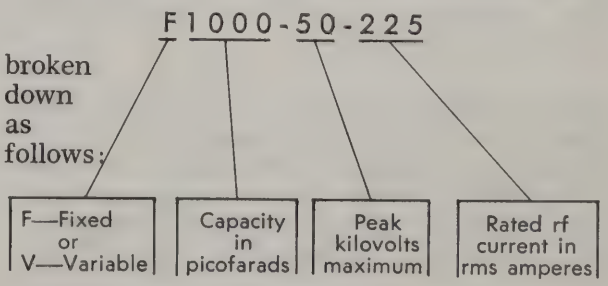
EIMAC VacCap* VACUUM CAPACITOR NUMBERING SYSTEM

Since 1945, all electron devices developed by Eitel-McCullough, Inc., have been given an identifying type number chosen in accordance with a coded system designed to convey essential information about the product in as brief a manner as possible.

Eimac VacCap* ceramic vacuum capacitor type numbers consist of (1) a letter denoting whether the capacitor is a fixed (F) or variable (V) unit; and (2) three sets of hyphenated numbers.

The first set of digits indicates the capacity value of the product, in picofarads. The second set of digits designates the maximum peak kilovolt rating. The third set specifies the maximum rf current in rms amperes.

This coding method and the information conveyed by the system is illustrated below. Assume that the unit is a fixed ceramic capacitor with ratings of 1000 picofarads, 50 kilovolts, and 225 amperes. The descriptive number is:



Eimac®

VacCap

EITEL-McCULLOUGH, INC.

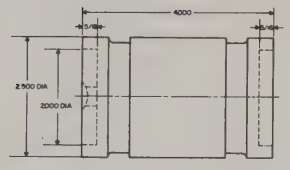
FIXED CERAMIC VacCap* CAPACITORS

TYPE	CAPACITY (pf)	VOLTAGE RATING (Peak kV)	CURRENT RATING (rms amps)	OUTLINE DRAWING
F200-7.5-100	200	7.5	100	A
F350-7.5-125	350	7.5	125	C
F500-7.5-125	500	7.5	125	C
F750-7.5-175	750	7.5	175	E
F1000-7.5-175	1000	7.5	175	E
F1500-7.5-200	1500	7.5	200	F
F200-10-100	200	10	100	A
F350-10-125	350	10	125	C
F500-10-125	500	10	125	C
F750-10-175	750	10	175	E
F1000-10-175	1000	10	175	E
F1500-10-200	1500	10	200	F
F50-20-100	50	20	100	A
F75-20-100	75	20	100	A
F100-20-100	100	20	100	A
F250-20-125	250	20	125	C
F350-20-125	350	20	125	C
F500-20-175	500	20	175	E
F750-20-200	750	20	200	F
F1000-20-200	1000	20	200	F
F50-25-100	50	25	100	A
F75-25-100	75	25	100	A
F100-25-100	100	25	100	A
F250-25-125	250	25	125	C
F350-25-125	350	25	125	C
F500-25-175	500	25	175	E
F750-25-200	750	25	200	F
F1000-25-200	1000	25	200	F
F50-30-100	50	30	100	A
F75-30-100	75	30	100	A
F100-30-100	100	30	100	A
F250-30-125	250	30	125	C
F350-30-125	350	30	125	C
F500-30-175	500	30	175	E
F750-30-200	750	30	200	F
F1000-30-200	1000	30	200	F

(Effective 2-15-65) © Eitel-McCullough, Inc. 1965

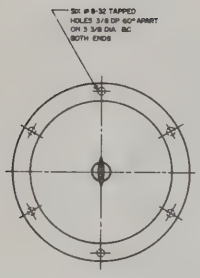
*Trademark

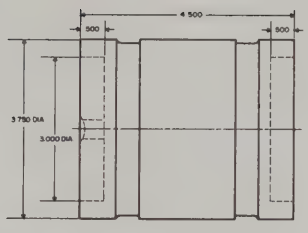




OUTLINE DWG. A

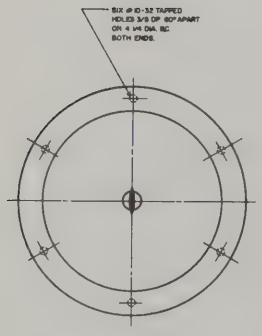


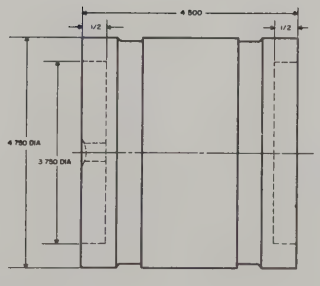




OUTLINE DWG C.

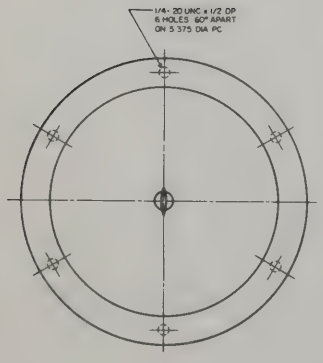


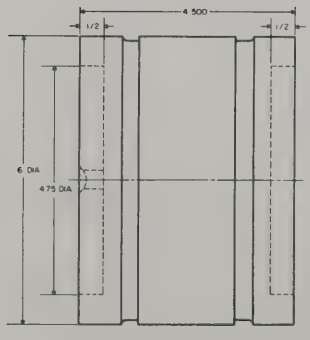




OUTLINE DWG. E







OUTLINE DWG. F

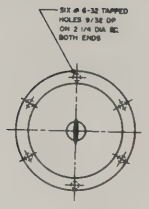


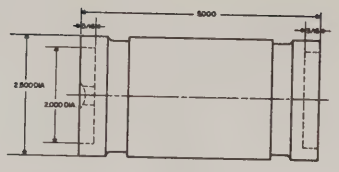
FIXED CERAMIC VacCap* CAPACITORS

TYPE	CAPACITY (pf)	VOLTAGE RATING (Peak kV)	CURRENT RATING (rms amps)	OUTLINE DRAWING
F50-40-100	50	40	100	B
F80-40-100	80	40	100	B
F100-40-125	100	40	125	D
F200-40-125	200	40	125	D
F500-40-200	500	40	200	G
F1000-40-225	1000	40	225	H
F50-45-100	50	45	100	B
F80-45-100	80	45	100	B
F100-45-125	100	45	125	D
F200-45-125	200	45	125	D
F500-45-200	500	45	200	G
F1000-45-225	1000	45	225	H
F50-50-100	50	50	100	B
F80-50-100	80	50	100	B
F100-50-125	100	50	125	D
F200-50-125	200	50	125	D
F500-50-200	500	50	200	G
F1000-50-225	1000	50	225	H

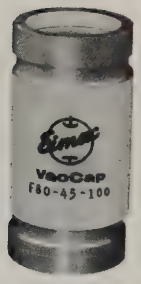
(Effective 2-15-65) © Eitel-McCullough, Inc. 1965

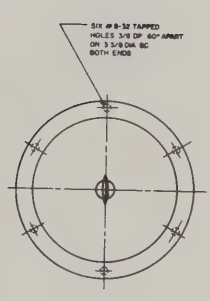
*Trademark

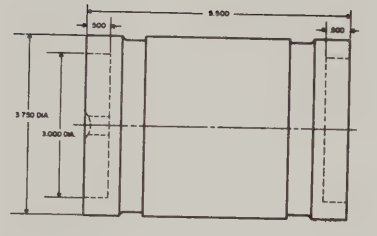




OUTLINE DWG. B

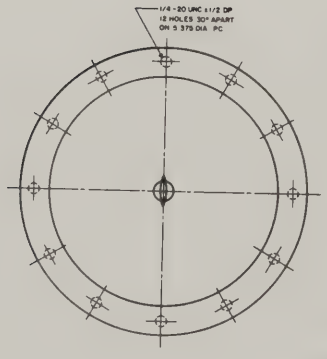


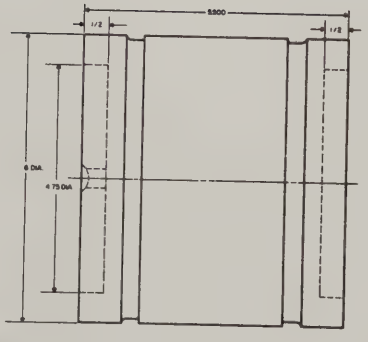




OUTLINE DWG. D

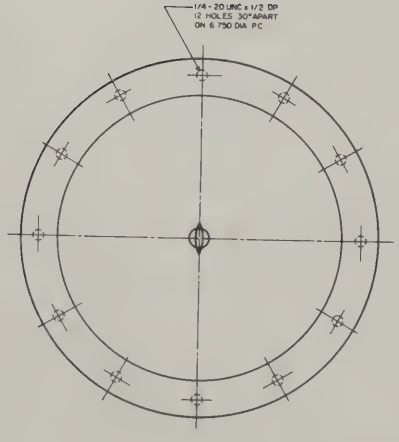


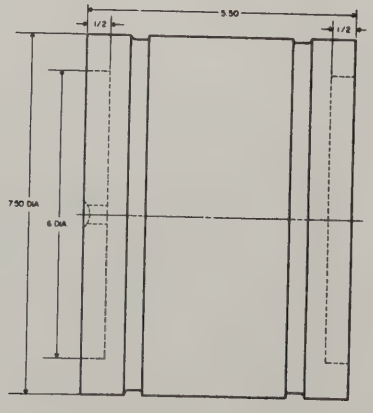




OUTLINE DWG. G







OUTLINE DWG H



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

5867A

AIR-COOLED MEDIUM MU POWER TRIODE



The Eimac 5867A is a power triode designed primarily for use in Industrial Heating applications. The large heat storage capacity of the graphite anode aids in compensating for the wide variations in loading generally associated with this type of sevrice. The 5867A is also suitable for use as an RF or AF Power Amplifier or Modulator.

The 5867A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling is greatly simplified by using the Eimac SK-410 Air-System Socket and SK-406 Air Chimney.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*
Filament: Thoriated Tungsten			
Voltage		5.0	volts
Current	13.5		14.7 amperes
Amplification Factor (E_b=2500 V, I_b=100 ma)		25	
Direct Interelectrode Capacitances			
Grid-Plate	5.0		6.2 uuf
Grid-Filament	6.5		8.0 uuf
Plate-Filament			0.5 uuf
Transconductance (I_b=100 ma)		5,000	umhos
Highest Frequency for Maximum Ratings			50 mc

MECHANICAL

Base	see drawing
Mounting	Vertical, base up or down
Cooling	Radiation and forced-air
Maximum Operating Temperatures:	
Plate Seals	220°C
Base Seals	180°C
Maximum Overal Dimensions:	
Height	5.875 inches
Diameter	3.438 inches
Socket	SK-410
Chimney	SK-406
Heat Radiator Connector	HR-6
Net Weight	6 ounces

(Effective 11-15-64) Copyright 1964 by Eitel-McCullough, Inc.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

CLASS-C FM or Telegraphy

MAXIMUM RATINGS

DC PLATE VOLTAGE	4,000 MAX. VOLTS
DC GRID VOLTAGE	—500 MAX. VOLTS
DC PLATE CURRENT	400 MAX. Ma.
PLATE DISSIPATION	350 MAX. WATTS
GRID DISSIPATION	30 MAX. WATTS

*Approximate Value.

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

DC Plate Voltage	2,000	3,000	4,000 volts
DC Grid Voltage	—150	—250	—350 volts
DC Plate Current	400	365	380 ma
DC Grid Current	80	70	80 ma
Peak Positive Grid Voltage	320	430	535 volts
Driving Power*	25	27	40 watts
Plate Input Power	800	1,090	1,520 watts
Plate Output Power	585	840	1,200 watts

CLASS-C OSCILLATOR, INDUSTRIAL APPLICATION SINGLE PHASE, FULL WAVE RECTIFIER, UNFILTERED

MAXIMUM RATINGS

DC PLATE VOLTAGE	3,800 MAX. VOLTS
DC GRID VOLTAGE	—500 MAX. VOLTS
DC PLATE CURRENT	360 MAX. Ma.
PLATE DISSIPATION	350 MAX. WATTS
GRID DISSIPATION	30 MAX. WATTS
PLATE INPUT POWER	1,500 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

DC Plate Voltage	2,750	3,500 volts
DC Plate Current	340	325 ma
DC Grid Current	60	65 ma
Grid Resistor	3,330	4,500 ohms
Plate Input Power	935	1,400 watts
Plate Output Power	685	1,100 watts

CLASS-C OSCILLATOR, INDUSTRIAL APPLICATION SELF-RECTIFIED

MAXIMUM RATINGS

PLATE VOLTAGE (r.m.s.)	4,500 MAX. VOLTS
DC GRID VOLTAGE	—500 MAX. VOLTS
DC PLATE CURRENT	210 MAX. Ma.
PLATE DISSIPATION	350 MAX. WATTS
GRID DISSIPATION	30 MAX. WATTS
GRID RESISTOR	100,000 MAX. OHMS
PLATE INPUT POWER	900 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

Plate Voltage (r.m.s.)	3,000	4,000 volts
DC Grid Voltage	—110	—280 volts
DC Plate Current	180	190 ma.
DC Grid Current	32	35 ma.
Plate Input Power	600	840 watts
Plate Output Power	415	630 watts
Grid Resistor	3,000	5,500 ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

MECHANICAL

Mounting

The 5867A must be operated vertically, base up or down. A flexible strap must be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling

Forced-air cooling is required to maintain base and plate seal temperatures below 180°C and 220°C, respectively. When using the Eimac SK-410 Air system socket and SK-410 Air Chimney, complete with the HR-6 Heat Radiator, a minimum air-flow in the base to anode direction of 12 cfm at sea level is required to provide adequate cooling at an inlet air temperature of 50°C. This flow rate corresponds to a static pressure drop of 0.1 inches of water. At higher inlet air temperatures, higher altitudes, or at frequencies above 50 mc, the air flow rate must be increased to give adequate cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, envelope and plate seals. In all cases, air flow rates in excess of the minimum requirements will prolong tube life.

ELECTRICAL

Filament Voltage

For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated 5.0 volts. Variations in the filament voltage must be kept within the range of 4.75 and 5.25 volts.

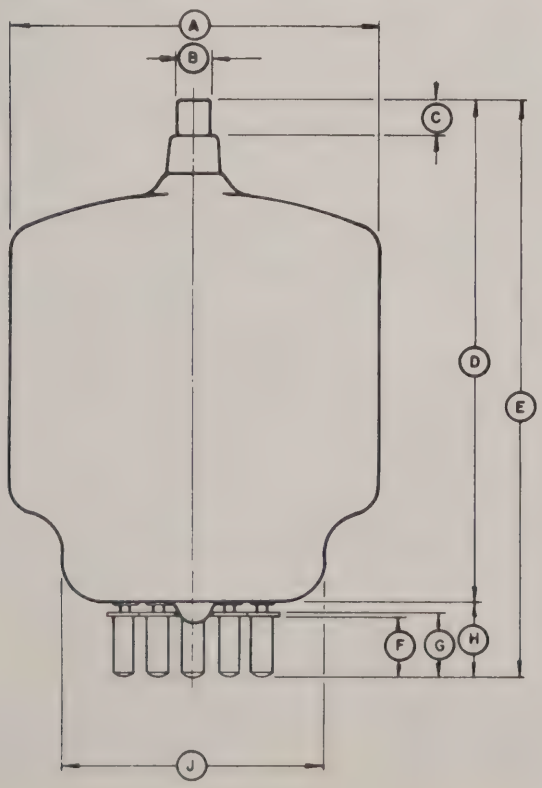
Grid Dissipation

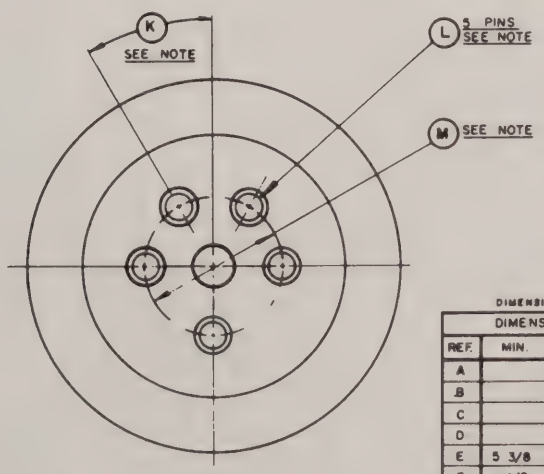
The rated grid dissipation of the Eimac 5867A is 30 watts. Grid dissipation is the approximate product of the dc grid current and the peak positive grid voltage. In equipment where the plate loading varies widely, such as radiofrequency heating oscillators, care should be taken to insure that the grid dissipation does not exceed the 30 watt maximum.

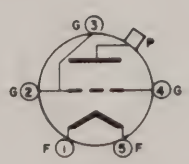
To prevent overheating of a grid pin by RF currents, it is advisable to connect all three grid pins into the circuit.

Special Applications

If it is desired to operate this tube under conditions widely different than those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.





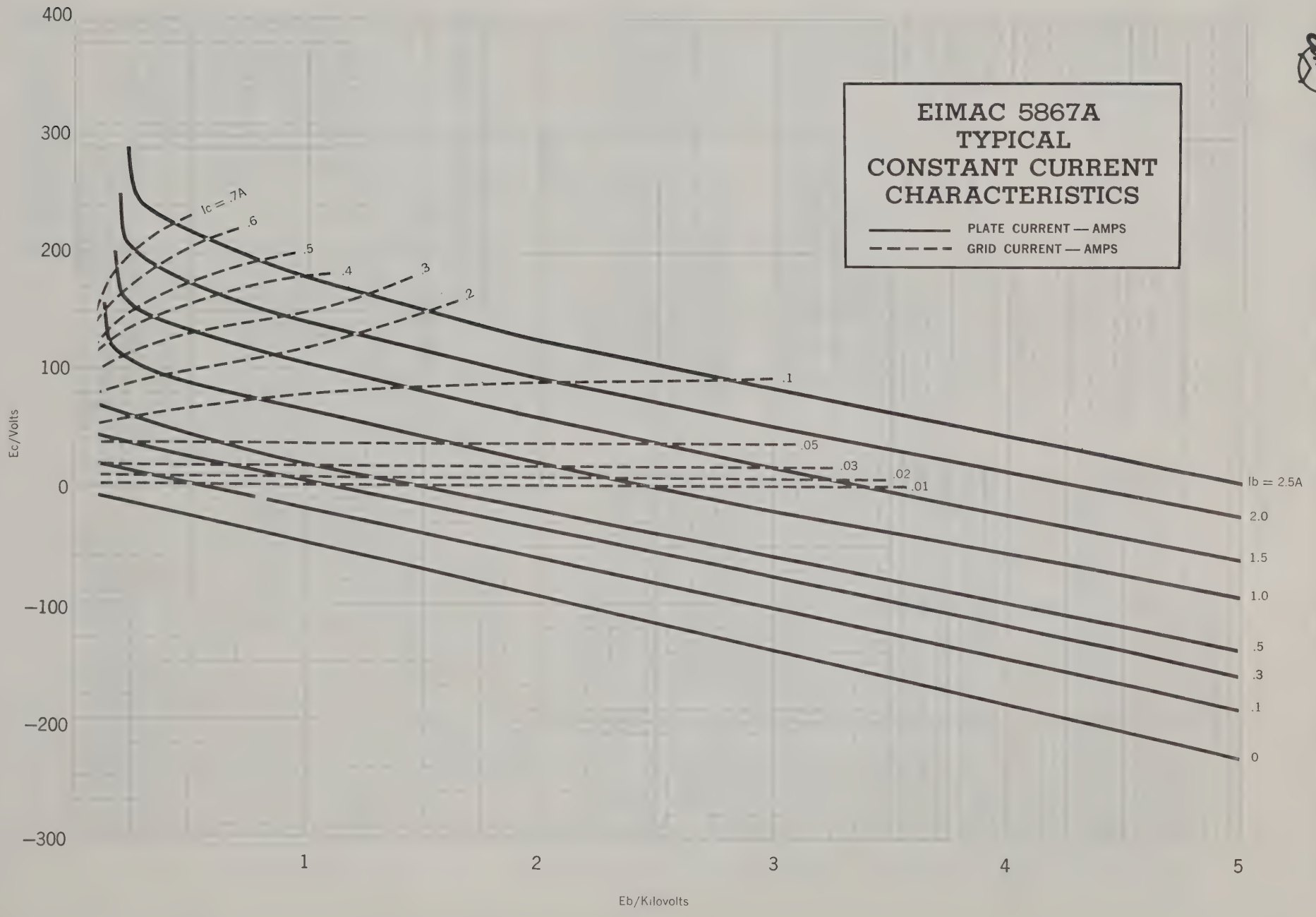


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3 7/16 D.	
B			.355 D.
C			.356 D.
D			4 27/32
E	5 3/8	5 7/8	
F	1/2	5/8	
G	9/16	11/16	
H			25/32
J		2 7/16 D.	
K			30° TYP
L	.185 D.	.191 D.	
M			1-1/4 D.P.C.

NOTE

BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA'S OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMENSIONS (K) & (M)


EIMAC 5867A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPS
GRID CURRENT — AMPS
Ec/Volts
Eb/Kilovolts
400
300
200
100
0
−100
−200
−300
1
2
3
4
5
Ic = .7A
.6
.5
.4
.3
.2
.1
.05
.03
.02
.01
Ib = 2.5A
2.0
1.5
1.0
.5
.3
.1
0

Eimac®

EITEL-McCULLOUGH, INC.

3CX2500A3

MEDIUM MU TRIODE

The Eimac 3CX2500A3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500A3 is an exact replacement for the Eimac 3X2500A3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube has a rugged, low-inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for V.H.F. operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals. The 3CX2500A3 may be installed or removed without the aid of tools.



ELECTRICAL — GENERAL CHARACTERISTICS

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	uuf
Grid-Filament	29.2		40.2	uuf
Plate-Filament	0.6		1.2	uuf
Transconductance (Ib = 830 ma., Eb = 3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			75	mc

MECHANICAL

Base	See drawing
Mounting	Vertical, base down or up
Cooling	Forced Air
Maximum Anode Core and Seal Temperatures	250°C
Maximum Over-all Dimensions:	
Length	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds
Shipping Weight (Average)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

(Conventional Neutralized Amplifier — Frequencies below 75Mc.)
Class-C FM or Telegraphy (Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. per tube)

D-C Plate Voltage	4000	5000	6000 volts
D-C Plate Current	2.5	2.5	2.08 amps
D-C Grid Voltage	−300	−450	−500 volts
D-C Grid Current*	245	265	180 ma
Peak R-F Grid Input Voltage*	580	750	765 volts
Driving Power*	142	197	136 watts
Grid Dissipation*	68	78	46 watts
Plate Power Input	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Power Output	7500	10,000	10,000 watts

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

(Conventional Neutralized Amplifier — Frequencies below 75Mc.)
Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	1670 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. per tube)

D-C Plate Voltage	4000	4500	5000 volts
D-C Plate Current	1.67	1.47	1.25 amps
D-C Grid Voltage	−450	−500	−550 volts
D-C Grid Current*	180	140	150 ma
Peak R F Grid Input Voltage*	685	715	760 volts
Driving Power*	125	100	115 watts
Grid Dissipation*	43	30	32 watts
Plate Power Input	6670	6615	6250 watts
Plate Dissipation	1670	1315	950 watts
Plate Power Output	5000	5300	5300 watts

*Approximate values.

(Effective 9-1-64) Coyright, 1962 by Eitel-McCullough, Inc.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	4000	5000	6000 volts
D-C Grid Voltage[1]	−150	−190	−240 volts
Zero-Signal D-C Plate Current	0.6	0.5	0.4 amps
Max-Signal D-C Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

Cooling —

Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 mc, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 mc).

Anode-to-Base Air Flow[1]				
	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air-Flow				
	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1]When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage —

The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

Bias Voltage —

There is little advantage in using bias voltages in excess of those given under "Typical Operation" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage —

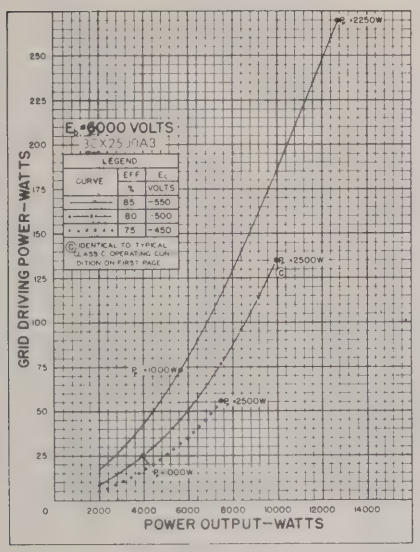
The plate-supply voltage for the 3CX2500A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

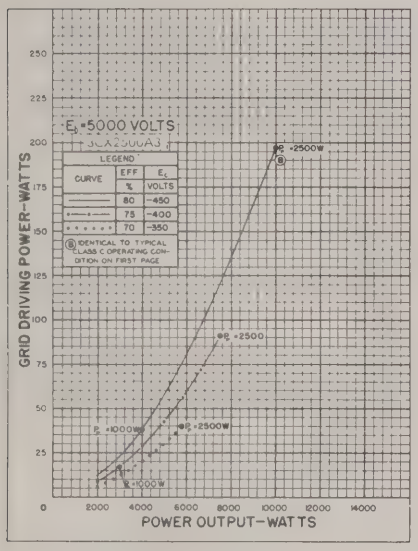
Grid Dissipation —

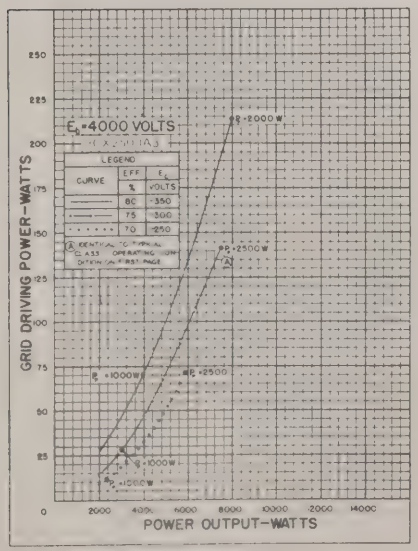
The power dissipated by the grid of the 3CX2500A3 must never exceed 150 watts. Grid dissipation is the product of d-c current and peak positive grid voltage.

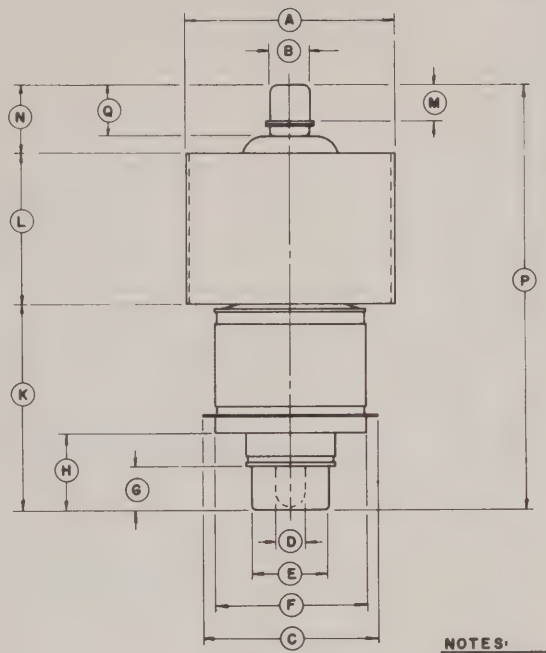
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

In VHF operation, particularly above 75 Mc., the d-c grid current must not exceed 200 ma. under any conditions of plate loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





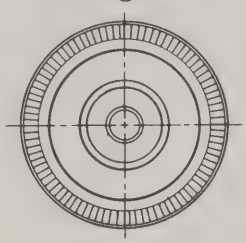




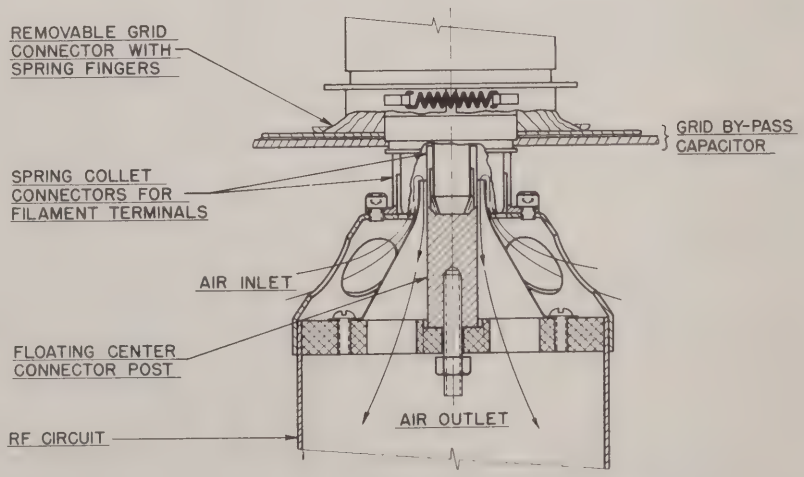
DIMENSIONAL DATA			
REF	MIN	MAX	NOM
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	.615	.635	
E	1.490	1.510	
F	2.990	3.010	
G	13/16	15/16	
H	1 3/8	1 5/8	
J	3/8	7/16	
K	3 7/8	4 1/4	
L	2 15/16	3 1/16	
M	11/16	13/16	
N	1 3/16	1 11/16	
P	8	9	
Q	1	1 1/8	

NOTES:

1. .040 MAXIUM RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAXIUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.
3. DIMENSIONS IN INCHES.



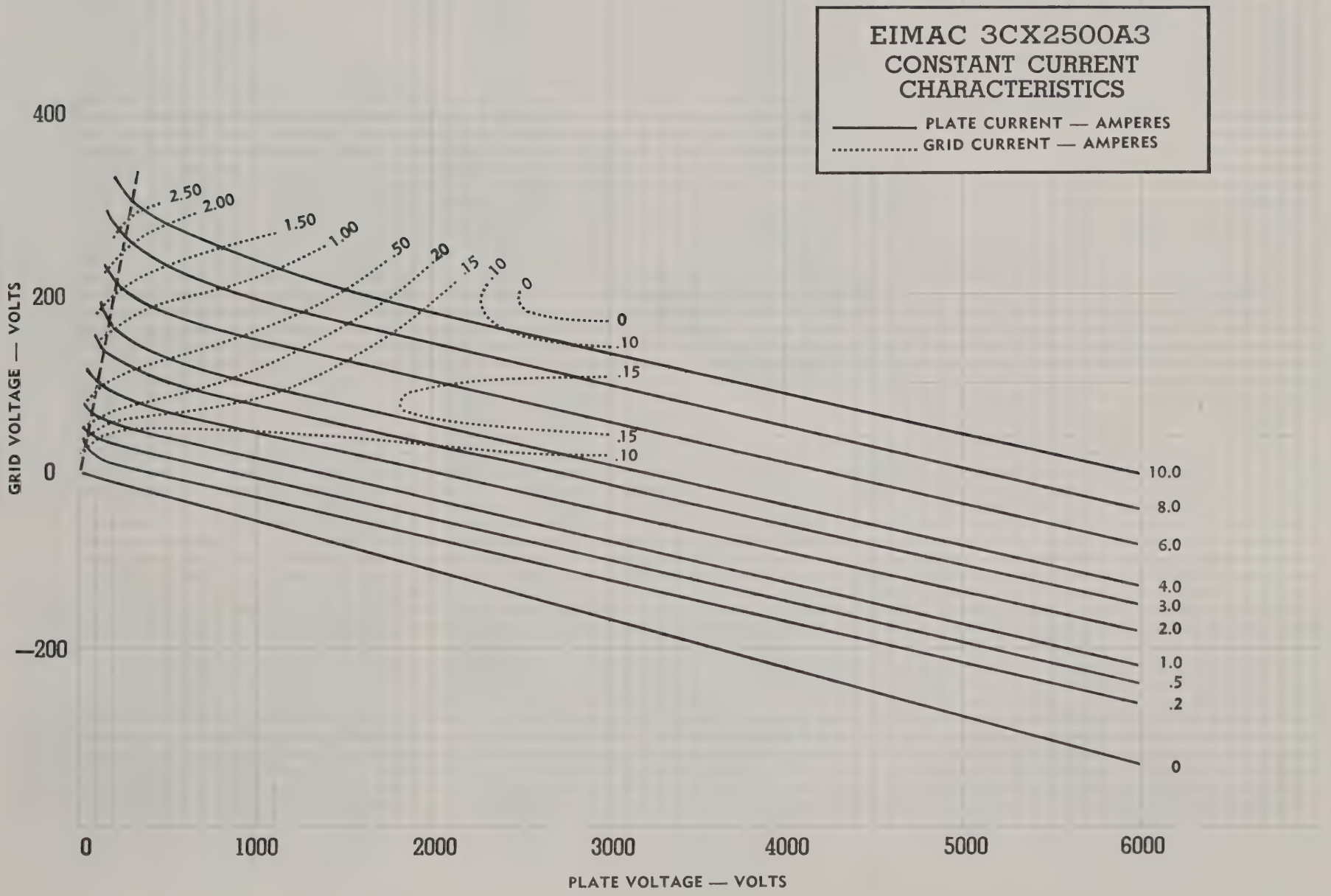
BOTTOM VIEW



TYPICAL TUBE CONNECTORS AND STEM COOLING

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3CX2500A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
400
200
0
—200
GRID VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

EITEL-McCULLOUGH, INC.

8240
3W5000A1

LOW-MU
WATER-COOLED
TRIODE



The Eimac 8240/3W5000A1 is a low-mu water-cooled power triode intended for use as an audio amplifier or modulator. The maximum rated plate dissipation is 5000 watts.

Two 3W5000A1's in class-AB_1 audio service will deliver more than 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

The 3W5000A1 is electrically identical to the air-cooled 3X3000A1 except for its plate dissipating rating.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor	4.4		5.6	
Direct Interelectrode Capacitances (Average)				
Grid-Plate		17		uufd
Grid-Filament		29		uufd
Plate-Filament		2.5		uufd
Transconductance (I_b = 1.0 amp., E_b = 3000V)		11,000		umhos
Maximum Frequency			75	Mc

MECHANICAL

Base	See outline drawing
Mounting Position	Vertical, base down or up
Cooling	Water and forced air
Maximum Temperatures:	
Grid and Filament Seals	175° C
Anode Cooler Core	250° C
Maximum Diameter	3.63 inches
Maximum Height	12.6 inches
Net Weight	3.5 pounds
Shipping Weight	15 pounds

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	6000 MAX.	VOLTS
DC PLATE CURRENT	2.5 MAX.	AMPERES
PLATE DISSIPATION	5000 MAX.	WATTS
GRID DISSIPATION	50 MAX.	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ±15%. Effective grid-circuit resistance must not exceed 200,000 ohms.

**At maximum signal without negative feedback.

TYPICAL OPERATION (Sinusoidal wave, two tubes)
Class-AB_1

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage (Approx)*	-860	-1080	-1300	volts
Zero-Signal DC Plate Current	500	400	335	mA
Max-Signal DC Plate Current	3.00	2.80	2.65	amps
Effective Load, Plate-to-Plate	2160	3320	4560	ohms
Peak AF Grid Input Voltage (per tube)	760	995	1250	volts
Max-Signal Driving Power	0	0	0	watts
Max-Signal Plate Input Power	12,000	14,000	16,000	watts
Max-Signal Plate Dissipation (per tube)	3000	3000	3000	watts
Max-Signal Plate Output Power	6000	8000	10,000	watts
Total Harmonic Distortion**	1.8	2.6	2.1	percent

(Effective 8-15-64) Copyright 1963-64 by Eitel-McCullough, Inc. Printed in U.S.A.

APPLICATION

MECHANICAL

Mounting: The 3W5000A1 must be mounted vertically with its base up or down at the convenience of the designer. The filament connections should be made through spring collets and care must be taken not to impart strain to the terminals or base.

The tube must be protected from severe shock and vibration during shipment and operation.

Cooling: Sufficient cooling must be provided to maintain seal and anode core temperature at 175°C or below. Cooling water and air-flow must be started when filament power is applied and it is advisable to continue for two minutes after all voltages are removed.

The table below lists minimum water-flow requirements to maintain tube temperatures below 175° C for various water-inlet temperatures. The water outlet temperature must not exceed 70° C and inlet water pressure must be less than 60 pounds per square inch. A separate air-flow supply of approximately six cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

MINIMUM WATER COOLING REQUIREMENTS

Water Inlet Temp. (°C)	Plate Dissipation							
	2 KW		3 KW		4 KW		5 KW	
	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI
20	1.7	0.68	2.6	1.3	3.9	2.3	5.6	3.9
30	2.3	1.1	3.2	1.7	4.5	2.8	6.2	4.5
40	3.0	1.6	3.8	2.2	5.3	3.5	6.9	5.3
50	3.9	2.3	4.7	3.0	6.0	4.3	7.7	6.1

Note:
An extra 425 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for grid and filament dissipation.

For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

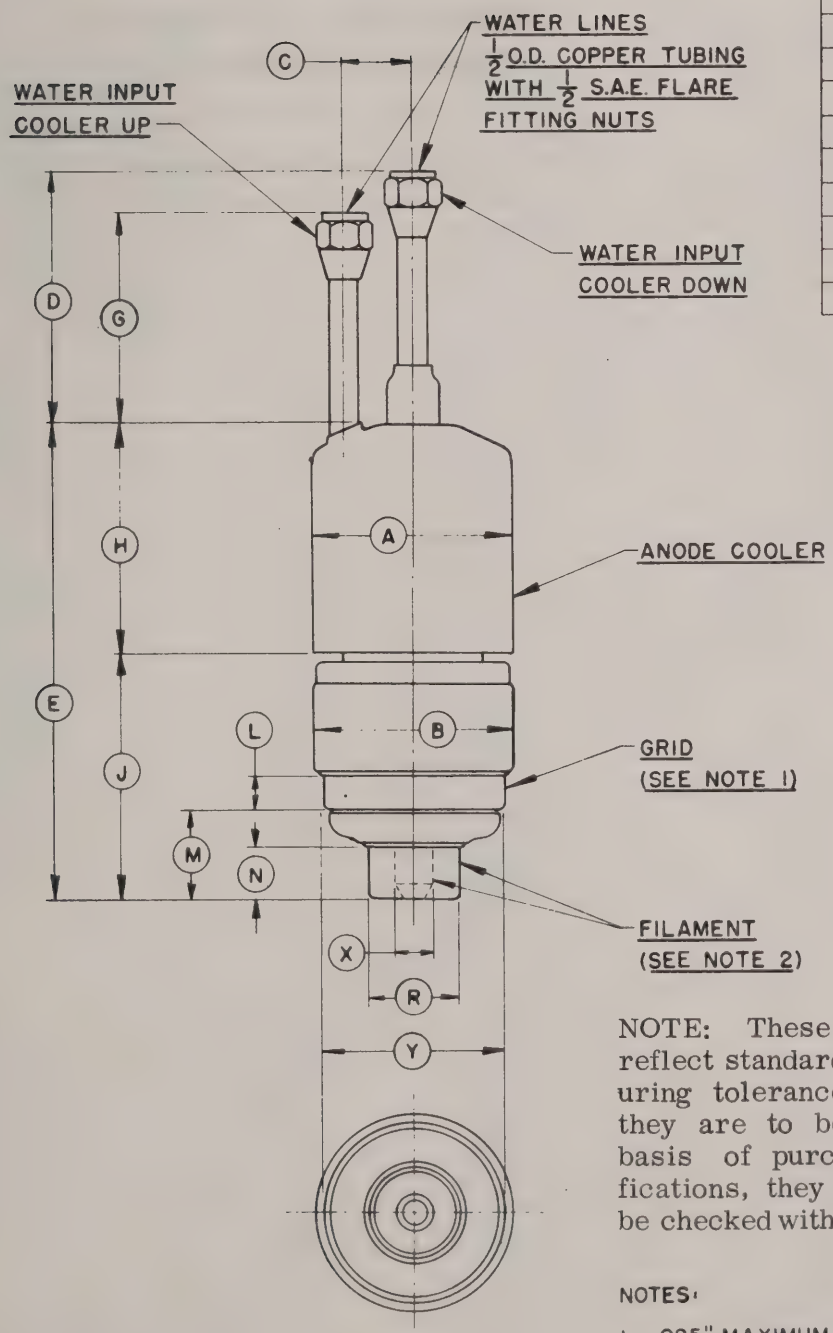
ELECTRICAL

Filament: The rated filament voltage for the 3W5000A1 is 7.5 volts and should not exceed this value by more than five percent if maximum tube life is to be realized. Reduction of filament voltage to about 7.2 volts will actually enhance tube life and provision should be made for this adjustment where the lower emission can be tolerated.

Grid Operation: The grid dissipation rating of the 3W5000A1 is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service, provision should be made for individual adjustment of bias voltage, in order to match the tubes. In practice, individual adjustment of drive voltage will not be necessary.

Special Applications: If it is desired to operate the tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

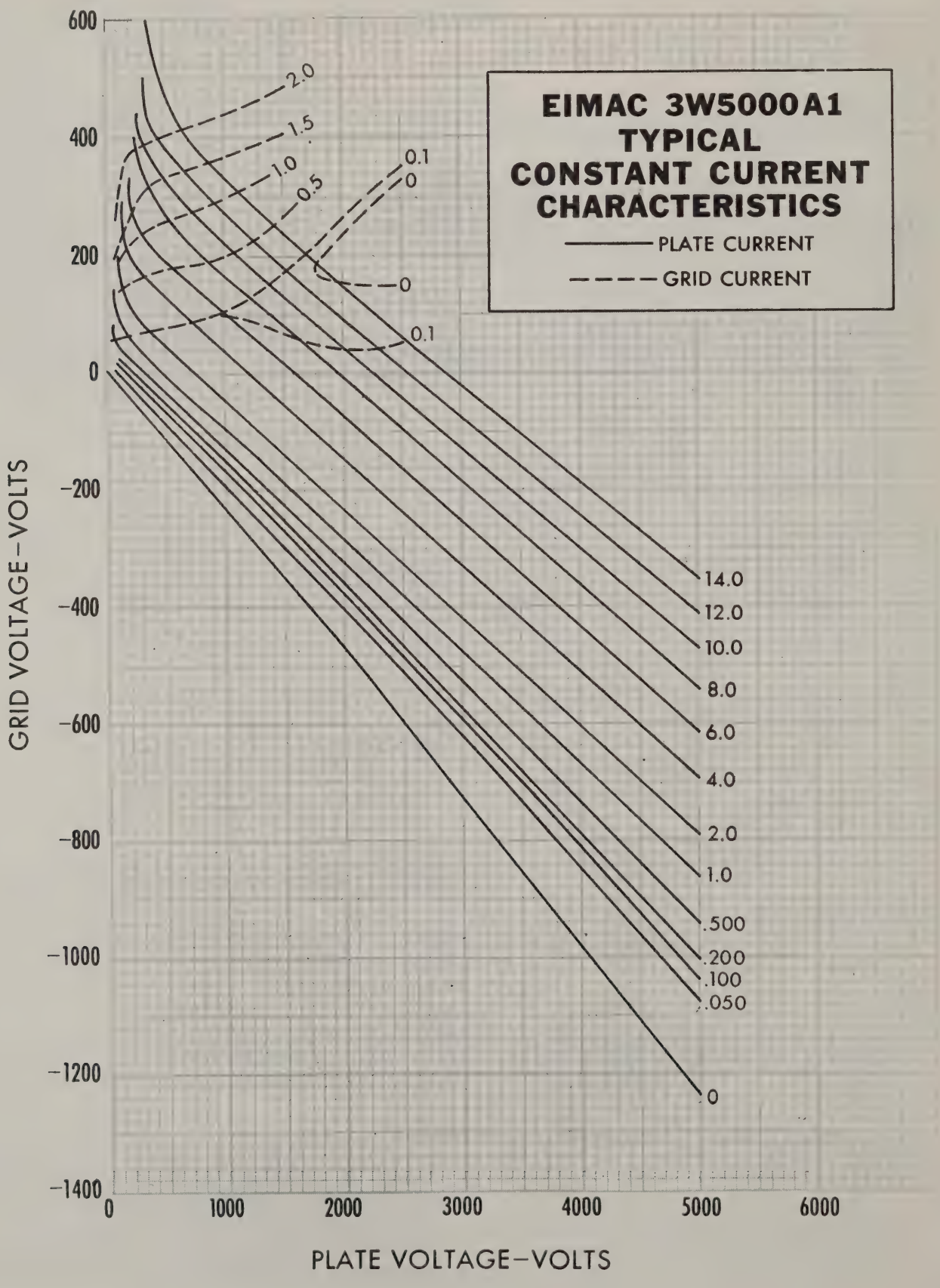
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.234	3.266
B			3.625
C		1.062	1.187
D		4.000	4.500
E		7.562	8.062
G		3.250	3.750
H		3.625	3.875
J		3.937	4.187
L		.375	.437
M		1.437	1.562
N		.812	.937
R		1.490	1.510
X		.615	.635
Y		2.990	3.010



NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.

NOTES:

1. .025" MAXIMUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.
2. DIMENSIONS IN INCHES.


EIMAC 3W5000A1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–VOLTS
600
400
200
0
−200
−400
−600
−800
−1000
−1200
−1400
0
1000
2000
3000
4000
5000
6000
2.0
1.5
1.0
0.5
0.1
0
0
0.1
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1.0
.500
.200
.100
.050
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TABLE OF CONTENTS

VOL. I

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	5-15-64
Eimac and EIA Tube Number Cross Reference Sheet	February '64
Power Frequency Chart for Power Grid	———

DIODES – RECTIFIERS – PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	8-1-64
253	7-1-52
575A & 673	3-16-64
5867A	11-15-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	12-1-63
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	4-9-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	11-1-63
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX2500A3	9-1-64
3CX25000F3	9-1-64
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	11-1-63
3CX15,000A3	4-11-64
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61
3X2500F3/8251	6-30-64
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	8-15-64
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61
4CX300A/8167	12-1-63
4CX300Y	11-1-63
4CX350A/8321 & 4CX350F/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	11-4-63
4CX1000K/8352	1-1-64
4CX3000A/8169	3-1-63
4CX5000A/8170	10-1-64
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	6-15-60
4X150G/8172	8-15-63
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5CX1500A	2-15-65

OTHER PRODUCTS	
VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
CS-8301 Laser Tube Assembly	10-5-64
EO-101 Detonator EO-201 Squib	11-15-64
Ceramic VacCap Vacuum Capacitors	2-15-65
SK-300A	11-1-64
SK-306, SK-316	5-21-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	8-15-64
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890, SK-806	4-9-64
SK-900, SK-906	6-1-60
SK-1300	5-9-63
SK-1306, SK-1406	5-17-63
SK-1400A, SK-1470A	5-9-63

*Not recommended for New Equipment Design.

Effective Date 4-30-65



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TABLE OF CONTENTS

VOL. I

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	5-15-64
Eimac and EIA Tube Number Cross Reference Sheet	February '64
Power Frequency Chart for Power Grid	———

DIODES – RECTIFIERS – PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	8-1-64
253	7-1-52
575A & 673	3-16-64
5867A	11-15-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	12-1-63
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	4-9-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	11-1-63
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX2500A3	9-1-64
3CX25000F3	9-1-64
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64

TRIODES (Continued)	
3CX10,000A7/8160	11-1-63
3CX15,000A3	4-11-64
3W5000A1/8240	8-15-64
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61
3X2500F3/8251	6-30-64
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	8-15-64
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50
6696A	10-15-64
6697A	10-15-64
7211	9-1-64
7480	10-15-64

TETRODES – PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61

TETRODES–PENTODES (Continued)	
4CX300A/8167	12-1-63
4CX300Y	11-1-63
4CX350A/8321 & 4CX350F/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	11-4-63
4CX1000K/8352	1-1-64
4CX3000A/8169	3-1-63
4CX5000A/8170	10-1-64
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	6-15-60
4X150G/8172	8-15-63
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5CX1500A	2-15-65

OTHER PRODUCTS	
VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
CS-8301 Laser Tube Assembly	10-5-64
EO-101 Detonator EO-201 Squib	11-15-64
Ceramic VacCap Vacuum Capacitors	2-15-65
SK-300A	11-1-64
SK-306, SK-316	5-21-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	8-15-64
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890, SK-806	4-9-64
SK-900, SK-906	6-1-60
SK-1300	5-9-63
SK-1306, SK-1406	5-17-63
SK-1400A, SK-1470A	5-9-63

*Not recommended for New Equipment Design.

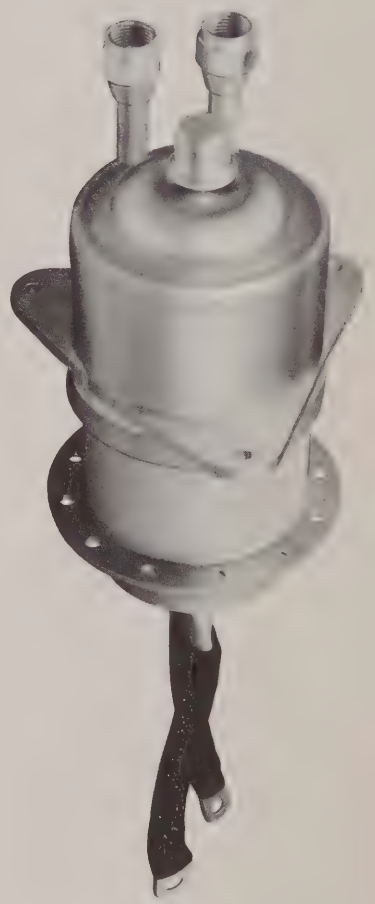
Effective Date 4-30-65

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

3CW20,000H3

MEDIUM-MU

WATER-COOLED POWER TRIODE



The Eimac 3CW20,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 20 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 40 kilowatts is permissable up to 90 megacycles. Plentiful reserve emission is available from its 750 watt filament. The grid structure is rated at 250 watts, making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	μμf
Plate-Filament	1.2		1.5	μμf
Grid-Plate	30		38	μμf
Frequency for Maximum Ratings			90	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 pounds

(Effective 2-1-65) Copyright 1965 by Eitel-McCullough, Inc.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,000 VOLTS
DC PLATE CURRENT	4.0 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	0.6 AMP
PLATE INPUT POWER	40 KW
PLATE DISSIPATION (NOMINAL)	20 KW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000 volts
DC Plate Current	4.0	4.0 amps
DC Grid Voltage	—670	—800 volts
DC Grid Current	.275	.315 amps
Peak Positive Grid Voltage	340	340 volts
Driving Power	260	340 watts
Plate Input Power	28	40 kW
Plate Dissipation	9	12 kW
Plate Output Power	19	28 kW
Approximate Load Impedance	720	1270 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW20,000H3 is 7.5 volts. Filament voltage, as measured at the tube, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

Control Grid Operation

The grid current rating is 0.6 ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.2 to 0.4 amp grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 250 watts.

Plate Operation

Maximum plate voltage rating of 12,000 volts and maximum plate current of 4.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded. The 40 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW20,000H3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting

The 3CW20,000H3 must be mounted vertically, either base up or down.

Cooling

The anode of the 3CW20,000H3 is cooled by circulating water through the integral anode-water jacket. The table below lists minimum water-flow rates at various plate dissipation levels. The table is based upon a water temperature rise of 20°C.

MINIMUM COOLING WATER-FLOW REQUIREMENTS

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
10	2	2.5
15	3	3.0
20	4	3.5
25	5	4.0

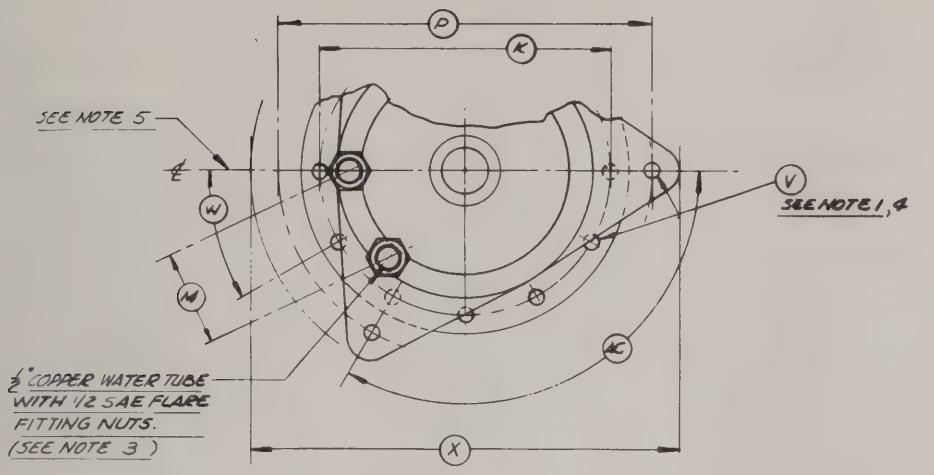
Since power dissipated by the filament represents 750 watts and grid dissipation can reach 250 watts, 1000 watts has been added to anode dissipation in preparing this tabulation.

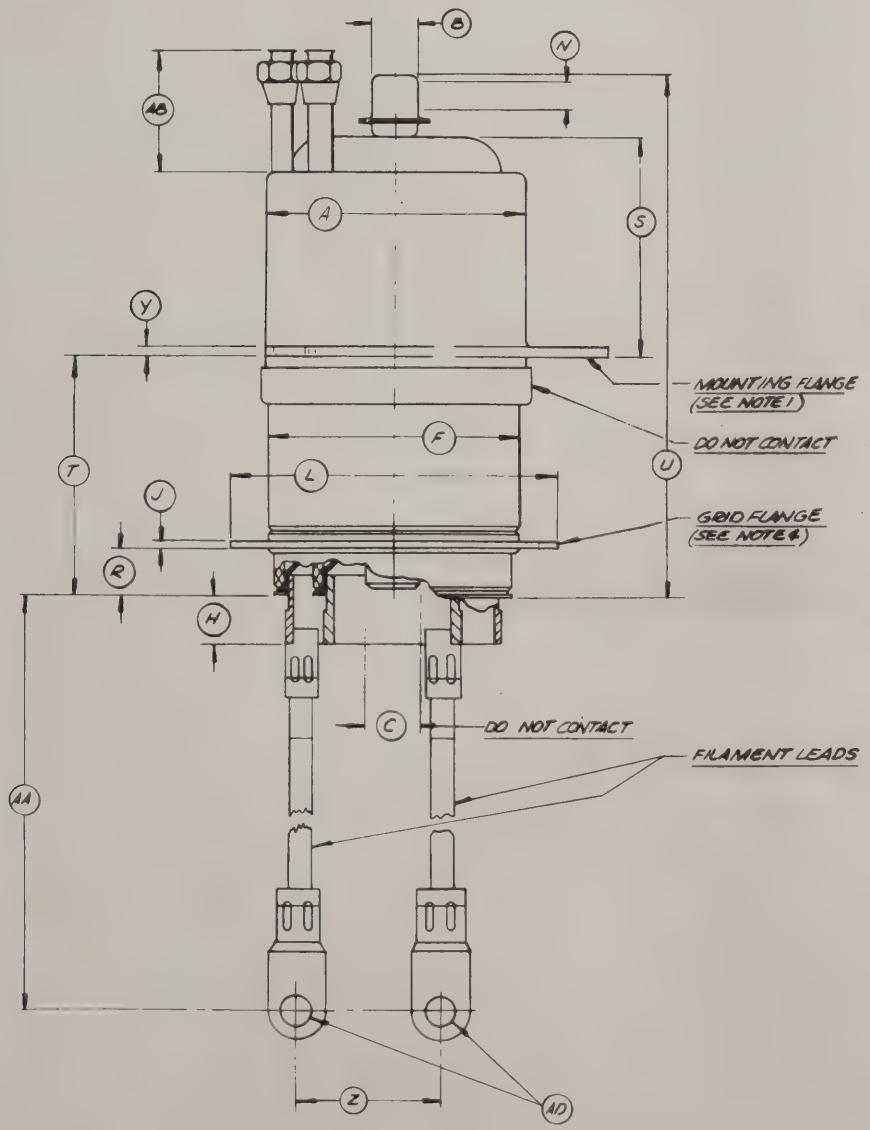
The cooling table assumes that the maximum outlet-water temperature will be below 70°C to preclude "spot" boiling.

Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 40 cfm of cooling air directed into the base structure will generally satisfy this requirement.

Special Application

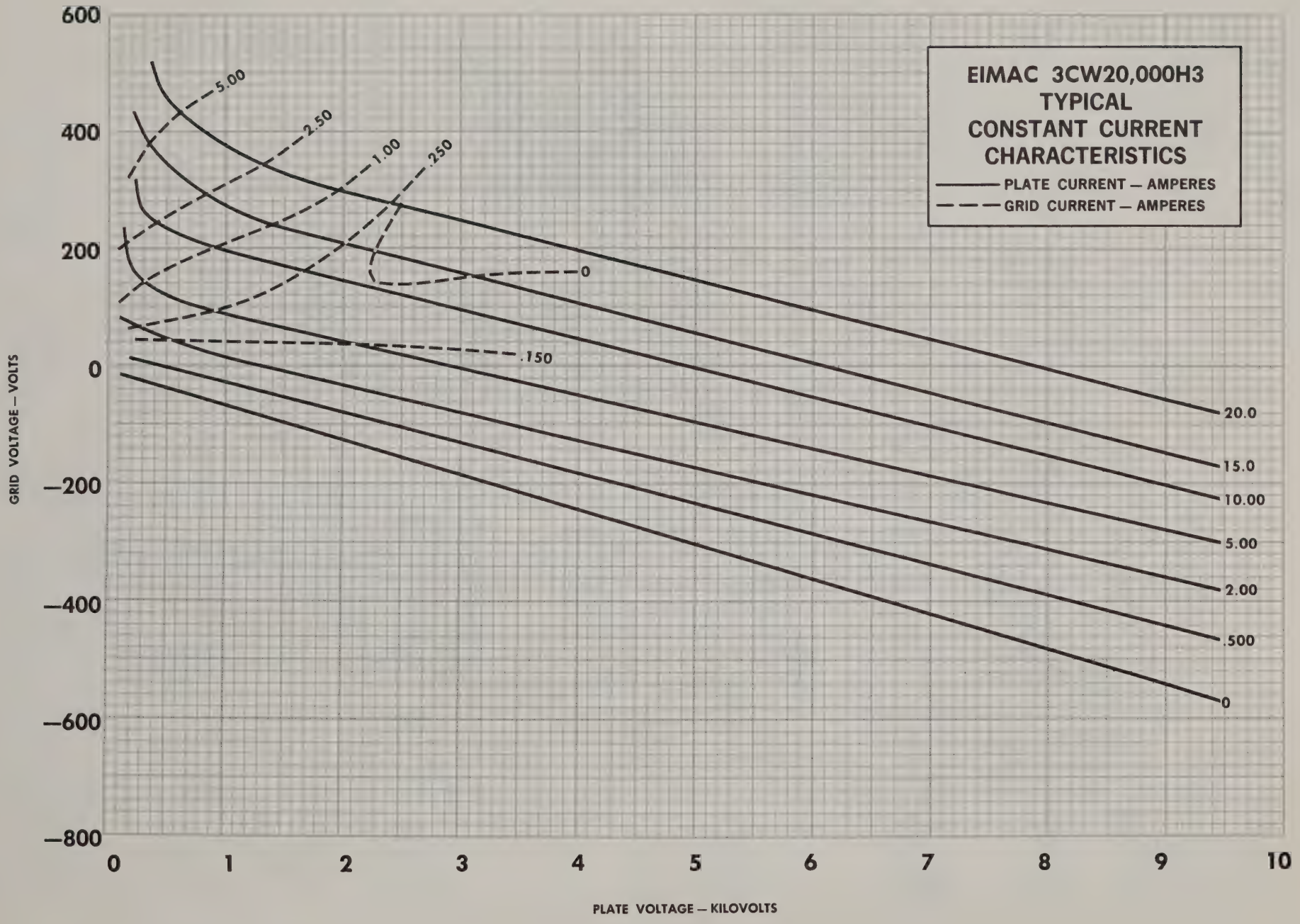
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, Calif. for information and recommendations.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.050	4.250	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.990	6.010	
R	.800	.860	
S	3.300	3.500	
T	3.950	4.100	
U	8.250	8.750	
V			.250
W	29°	31°	
X			6.750
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390

NOTES:
1. 3 MOUNTING HOLES IN MTG. FLANGE.
2. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. 12 HOLES IN GRID FLANGE
5. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.

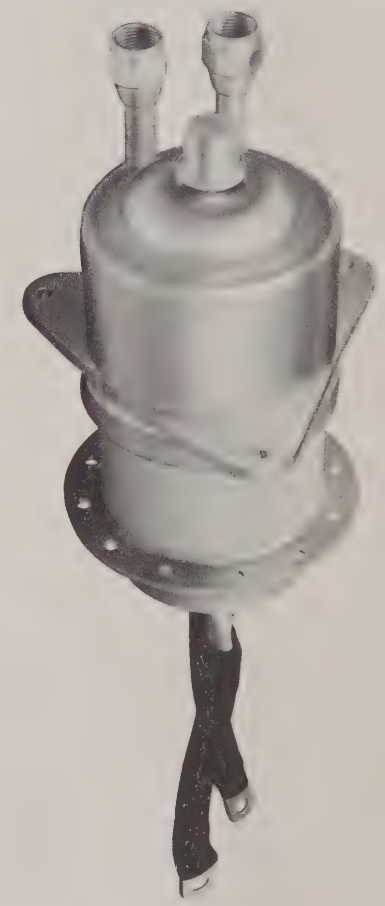

EIMAC 3CW20,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — KILOVOLTS
600
400
200
0
−200
−400
−600
−800
0
1
2
3
4
5
6
7
8
9
10
5.00
2.50
1.00
.250
0
.150
20.0
15.0
10.00
5.00
2.00
.500
0

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

3CW30,000H3

MEDIUM-MU

WATER-COOLED POWER TRIODE



The Eimac 3CW30,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 30 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 60 kilowatts is permissable up to 90 megacycles. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		volts
Current	152		172	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	μμf
Plate-Filament	1.2		1.5	μμf
Grid-Plate	30		38	μμf
Frequency for Maximum Ratings			90	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 pounds

(Effective 2-1-65) Copyright 1965 by Eitel-McCullough, Inc.

RF INDUSTRIAL OSCILLATOR
Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION (NOMINAL)	30 KW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000 volts
DC Plate Current	6.0	6.0 amps
DC Grid Voltage	—600	—800 volts
DC Grid Current	.66	.315 amps
Peak Positive Grid Voltage	440	360 volts
Driving Power	660	365 watts
Plate Input Power	42	60 kW
Plate Dissipation	12	18 kW
Plate Output Power	30	42 kW
Approximate Load Impedance	600	750 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW30,-000H3 is 6.3 volts. Filament voltage, as measured at the tube, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation

Maximum plate voltage rating of 12,000 volts and maximum plate current of 6.0 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 60 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW30,000H3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting

The 3CW30,000H3 must be mounted vertically, either base up or down.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 20°C temperature rise.

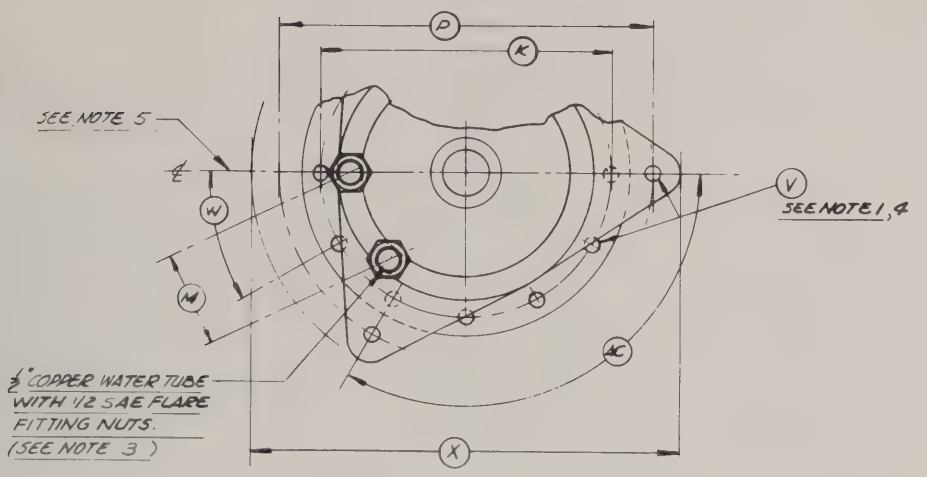
MINIMUM WATER-COOLING REQUIREMENT

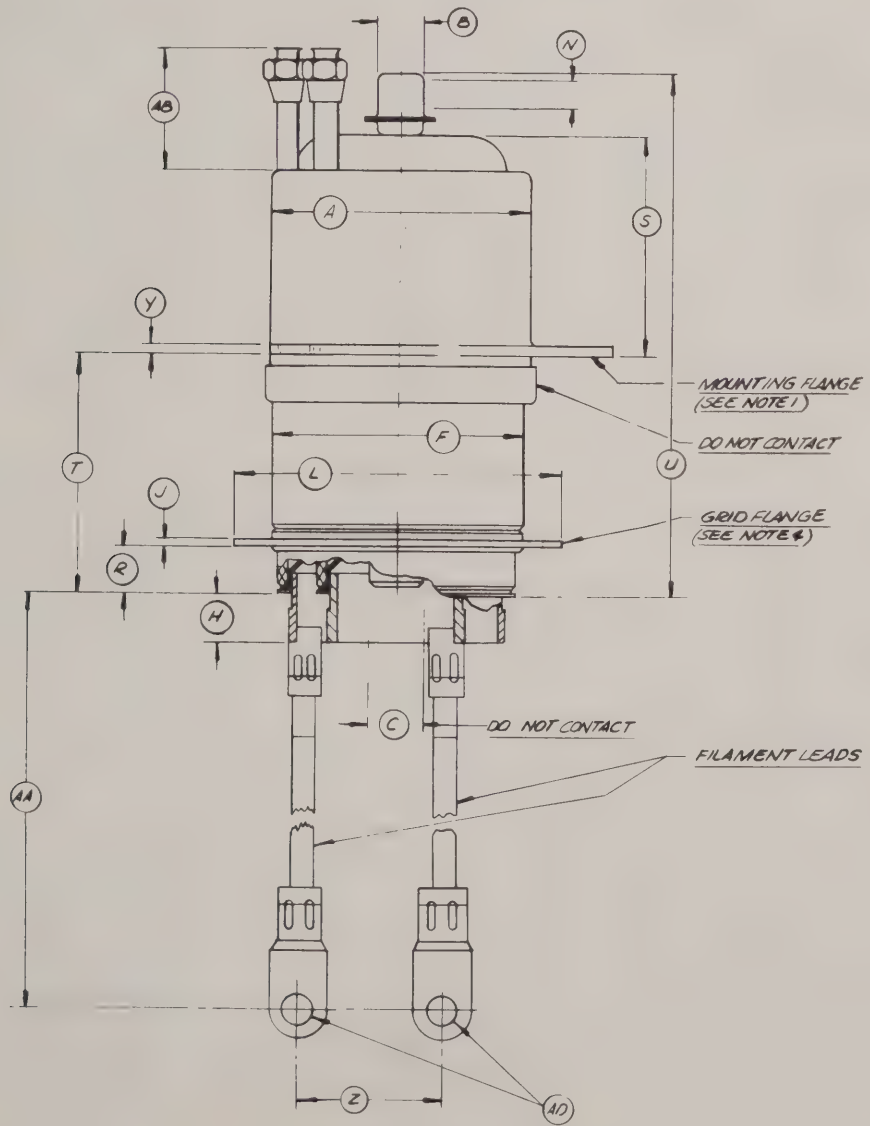
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
20	4	3.5
25	5	4.0
30	6	4.5
35	7	5.0

Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 50 cfm of cooling air directed into the base structure will generally satisfy this requirement.

Special Application

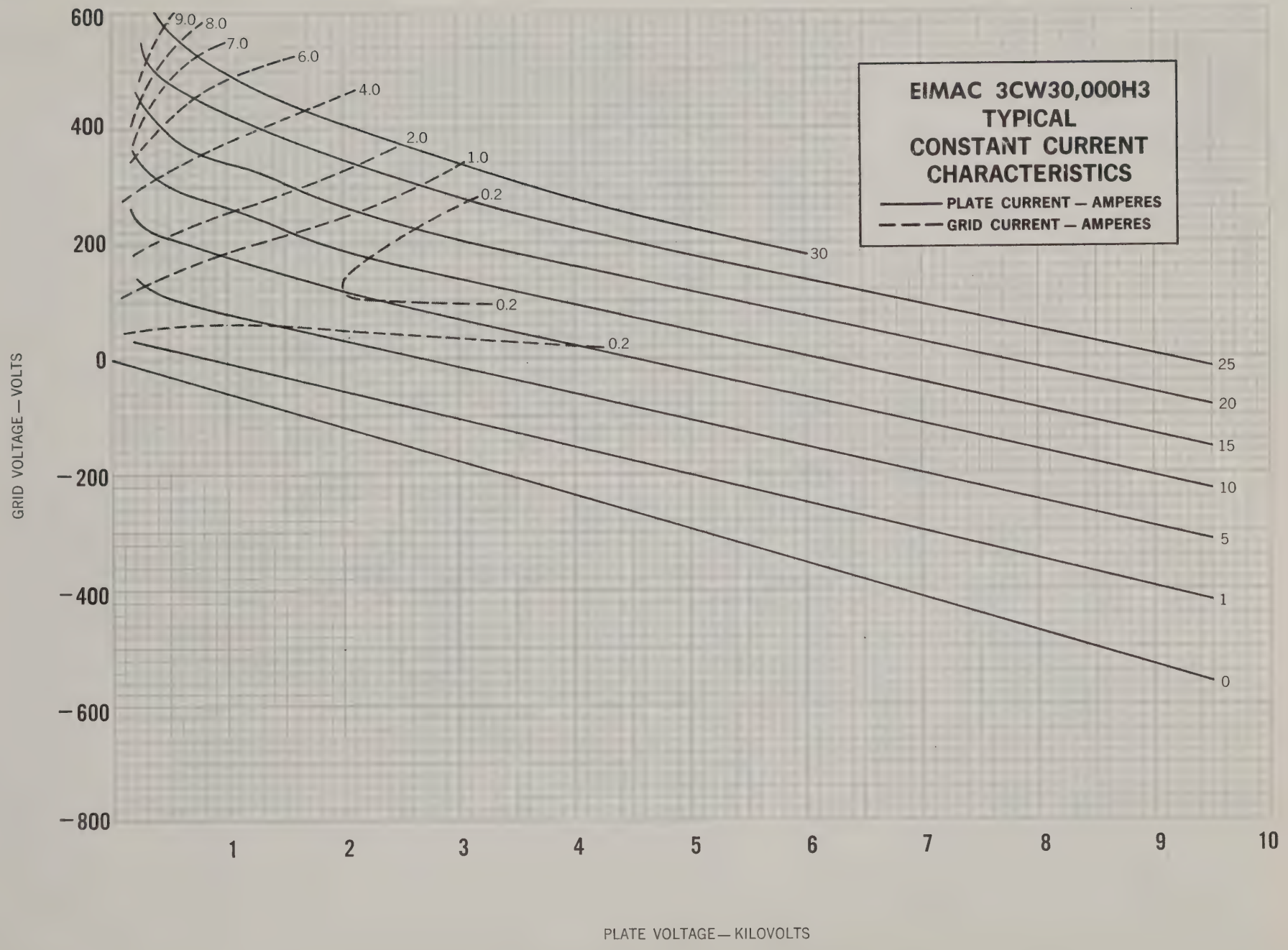
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, Calif. for information and recommendations.





DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.050	4.250	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.990	6.010	
R	.800	.860	
S	3.300	3.500	
T	3.950	4.100	
U	8.250	8.750	
V			.250
W	29°	31°	
X			6.750
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390

NOTES:
1. 3 MOUNTING HOLES IN MTG FLANGE.
2. REF: DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. 12 HOLES IN GRID FLANGE
5. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW30,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE — KILOVOLTS
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
30
25
20
15
10
5
1
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4X250B

RADIAL-BEAM POWER TETRODE



The 4X250B is a compact, forced-air cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 250 watts. The 4X250B is capable of producing 390 watts of output power at frequencies up to 175 megacycles, and at the maximum rated frequency of 500 megacycles a minimum of 225 watts may be obtained.

The 4X250B has low driving-power requirements and is capable of producing up to 70 watts of output power with a plate supply of 500 volts, making it an excellent choice for mobile applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-heater Potential	-	-	±150	volts
Heater: Voltage 4X250B	-	6.0		volts
Current 4X250B	2.3		2.9	amperes
Amplification Factor (Grid-to-Screen)	4.4		6.0	
Transconductance (I_b = 200 ma)	-	12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	14.2		17.2	uuf
Output	4.0		5.0	uuf
Feedback	-	-	0.06	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input	-	13.0		uuf
Output	4.0		5.0	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	500	mc

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
▶ Height	2.464 inches
▶ Seated Height	1.910 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 175Mc				500Mc	
D-C Plate Voltage	500	1000	1500	2000	2000	volts
D-C Screen Voltage	250	250	250	250	300	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	10**	ma
D-C Grid Current*	35	31	28	26	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**	watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit.

(Effective 1-1-60) Copyright 1960 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 8-18-58

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)
MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	500	1000	1500 volts
D-C Screen Voltage	250	250	250 volts
D-C Grid Voltage	—100	—100	—100 volts
D-C Plate Current	200	200	200 ma
D-C Screen Current*	31	22	20 ma
D-C Grid Current*	15	14	14 ma
Peak R-F Grid Input Voltage*	118	117	117 volts
Driving Power*	1.8	1.7	1.7 watts
Plate Input Power	100	200	300 watts
Plate Output Power	60	145	235 watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1
MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	200	200	200 ma
Max-Signal D-C Plate Current	500	500	500 ma
Max-Signal D-C Screen Current	20	16	10 ma
Effective Load, Plate to Plate	3500	6200	9500 ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	240	430	600 watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)
MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
D-C Plate Current	150	150	150 ma
D-C Screen Current*	—3	—4	—4 ma
Peak R-F Grid Voltage*	25	25	25 volts
Plate Output Power	30	50	65 watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)
MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
Peak R-F Grid Voltage*	50	50	50 volts
D-C Plate Current	250	250	250 ma
D-C Screen Current*	10	8	5 ma
Plate Input Power	250	375	500 watts
Plate Output Power	120	215	300 watts
Two-Tone Average D-C Plate Current	190	190	190 ma
Two-Tone Average D-C Screen Current*	2	—1	—2 ma

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X250B may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen by-pass capacitors and may be obtained with either grounded or ungrounded cathode terminals.

The tube will fit in a standard Loktal socket, but use of the Loktal socket is *not* recommended. The use of a Locktal socket in the usual way does not provide for cooling the base of the tube.

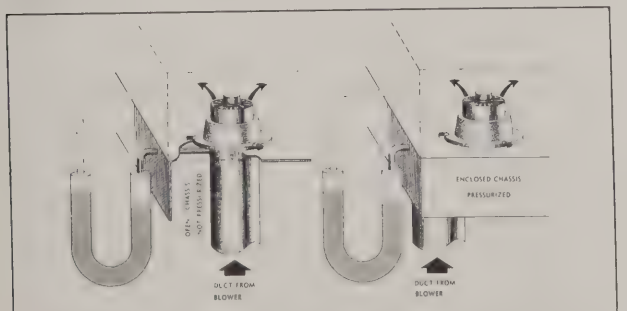
▶ **Cooling**—Sufficient cooling must be provided for the anode, base seals and body seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Glass-to-Metal Seals	175°C
Anode Core	250°C

Air requirements to maintain seal temperatures at 175°C in 50°C ambient air are tabulated below. These requirements apply when the Eimac SK-600 or SK-610 socket is used with air flow in the *base to anode* direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	3.8	0.28	5.5	0.40
250	5.6	0.53	8.1	0.77

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.



When exhaust air is restricted by a closed compartment (dotted lines), manometer return must be made to the compartment, not to free atmosphere.

METHODS OF MEASURING PRESSURE DIFFERENTIAL

At 500 Mc. or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which might interfere with effective cooling.

If cooling methods other than forced air are used, if the recommended air-flow rates are not supplied or if there is any doubt that the cooling is adequate, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperatures is by the use of a temperature-sensitive lacquer. When temperature-sensitive materials are used, extremely thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

Vibration—These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the Eimac 4CX300A be employed.

ELECTRICAL

Heater—The rated heater voltage for the 4X250B is 6.0 volts and this voltage should be maintained as closely as practicable. Short-time variations of the voltage of ±10% of the rated value will not damage the tube, but variations in performance must be expected. The heater voltage should be maintained within ±5% of its rated value to minimize variations in performance and to obtain maximum tube life.

At frequencies above approximately 300 megacycles transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, and driving power being supplied to the tube. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Freqency, Mc.	4X250B
300 and lower	6.0 volts
301 to 400	5.75 volts
401 to 500	5.50 volts

In no case should the heater of the 4X250B be operated at less than 5.4 volts.

Cathode Operation—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated d-c input current is 200 milliamperes for plate-modulated operation, and 250 milliamperes for all other types of operation except pulsed.

Higher cathode currents are permitted in pulsed operation and the maximum permissible pulse currents will depend entirely on the pulse lengths and the pulse repetition rates. The maximum rated pulse plate current of 6.0 amperes may be used only when the pulses do not exceed five microseconds in duration, and when the repetition rate does not exceed 1000 pulses per second. The curve of Fig. 2 shows the maximum permissible pulse currents and pulse durations for repetition rates of 1000 pps or less. For higher repetition rates the indicated pulse durations must be shortened by the factor 1000/n, where n is the number of pulses per second.

▶ Indicates change from sheet dated 1-3-58

The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Control-Grid Operation— The maximum rated d-c grid bias voltage is −250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rated power. At operating frequencies above the 100-megacycle region, driving-power requirements for amplifiers increase noticeably until at 500 megacycles as much as 30 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than the grid dissipation, so that the grid dissipation is only slightly increased. Satisfactory 500-megacycle operation of the tubes in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak a-c or r-f signal voltage applied to screen or cathode.

Protection for the screen can be provided by an over-current relay and by interlocking the screen supply so that the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions, and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using this tube may not be satisfactory because of the screen—voltage—screen—current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a separate small modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation of plate-modulated r-f amplifiers using the 4X250B

Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine-wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 megacycles the top cap on the anode cooler may be used for a plate terminal. At higher frequencies, a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler should be used.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

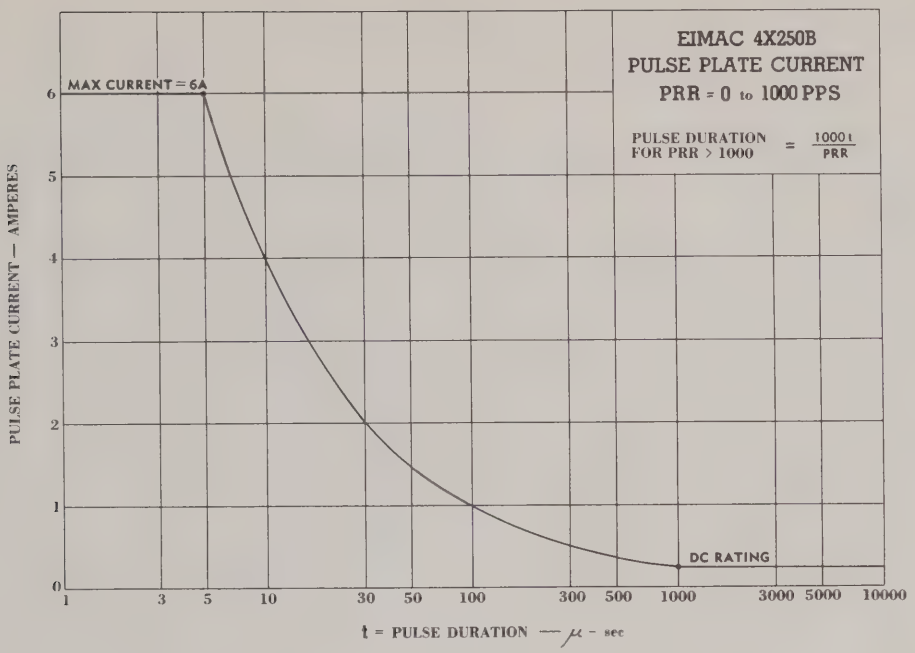
Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

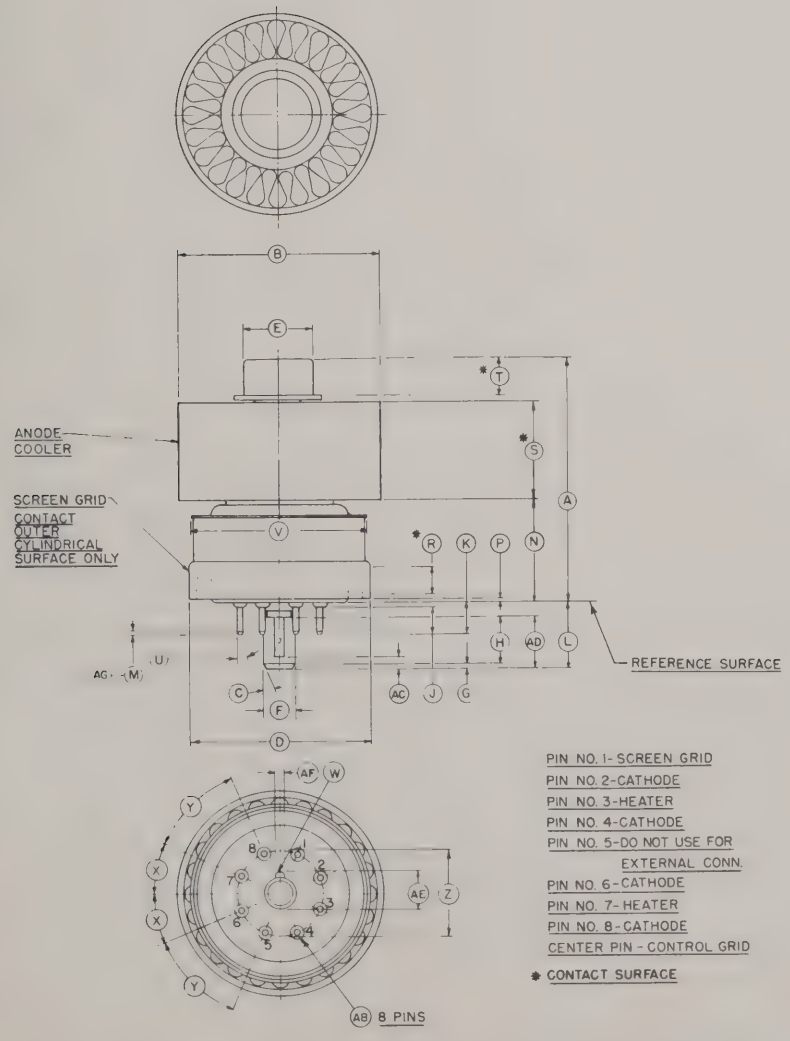
UHF Operation—The 4X250B is useful in the UHF region. UHF operation should be conducted with heavy plate loading, minimum bias and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Some of the added circuit loss observed in UHF operation is in the base insulator of the tube. It is sometimes necessary to use more than the recommended minimum air-flow rates to maintain safe operating base temperatures at UHF.

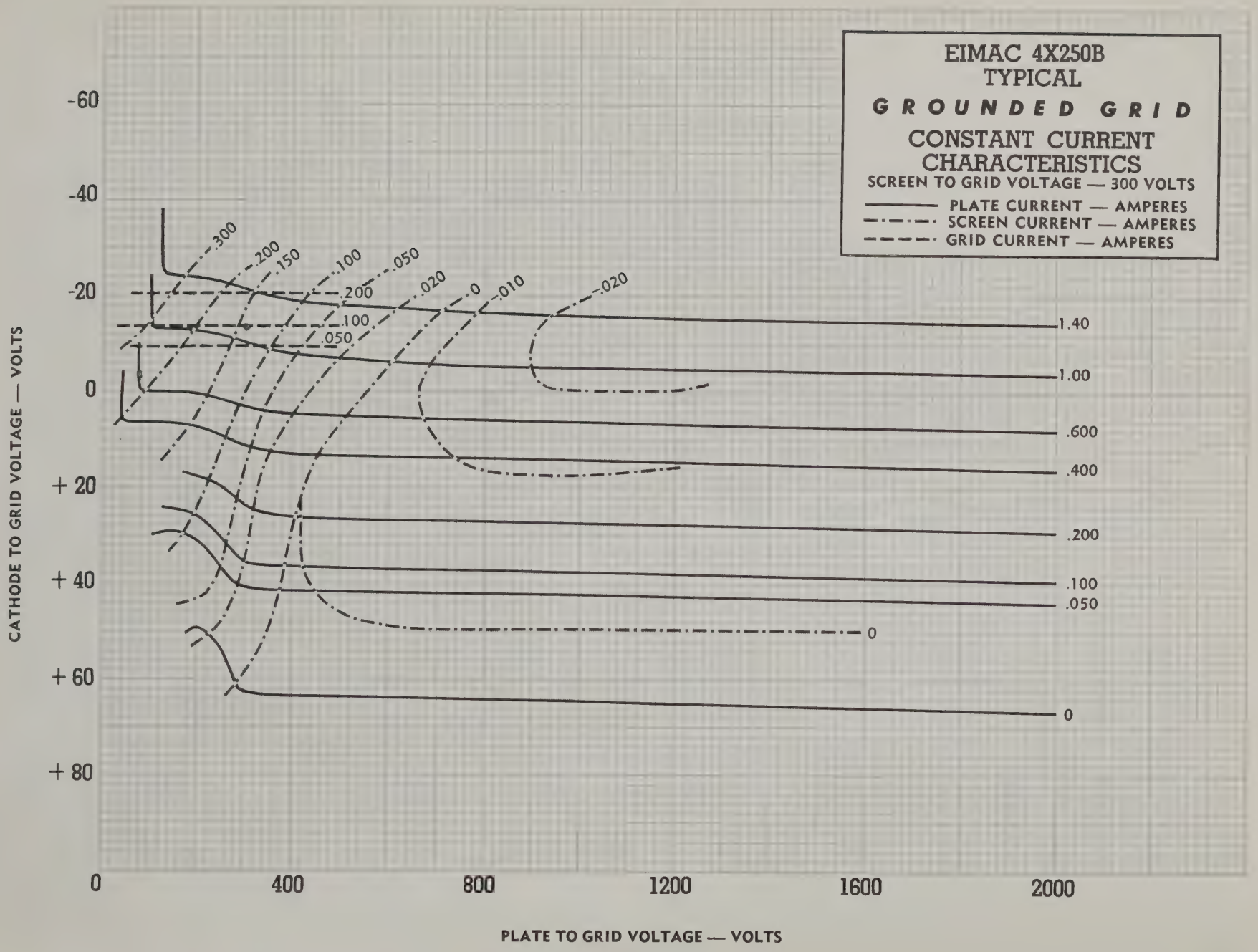
These tubes may be used in frequency multiplier applications. Such operation results in low plate efficiency and requires high driving voltages. If the frequency multiplier is used as an output power stage, it is preferable to operate the final tube as a frequency doubler rather than a frequency tripler.

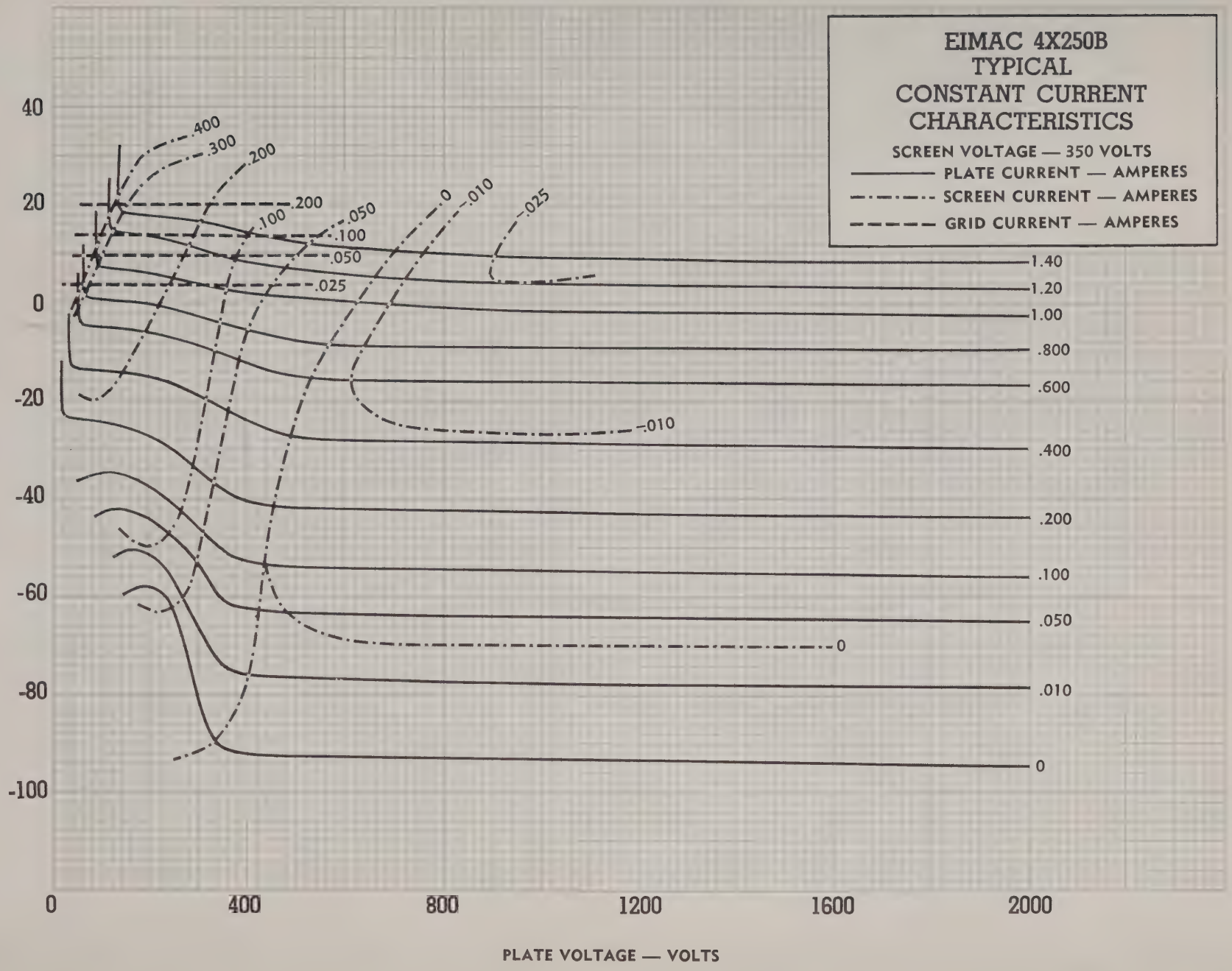
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

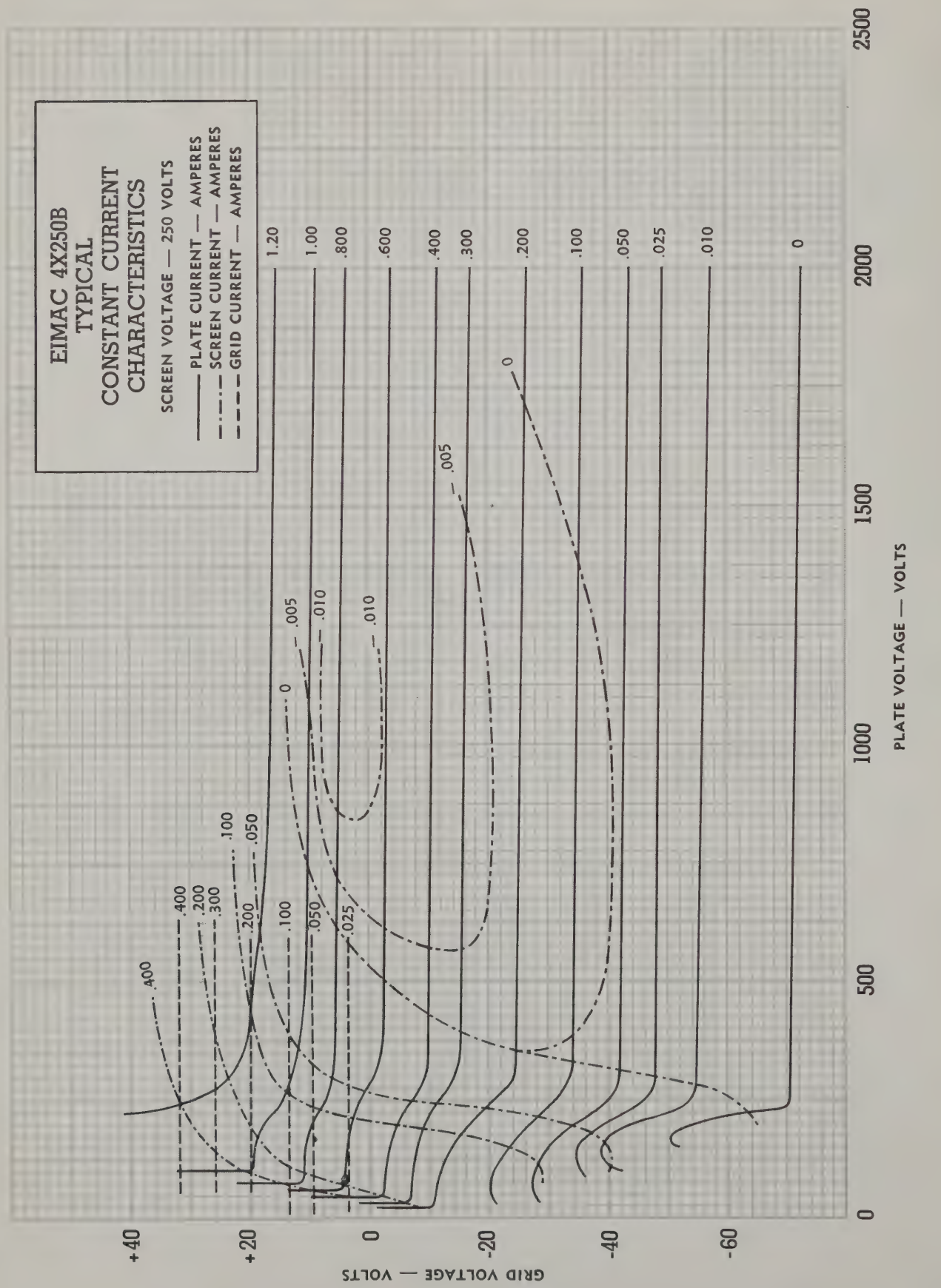




DIMENSIONS IN INCHES		
REF.	MIN.	MAX.
A	1.810	1.910
B	1.610 DIA.	1.640 DIA.
C	30°	
D	1.417 DIA.	1.433 DIA.
E	.559 DIA.	.573 DIA.
F	.255 DIA.	.265 DIA.
G	.031	
H	.360	
J	.187	
K		.250
L	.514	.554
M	.035	
N	.750	.810
P	020	
R	.187	
S	.710	790
T	.240	.280
U	22 1/2°	
V		1.406 DIA.
W		.043 R.
X	22 1/2°	
Y	45°	
Z	.680 DIA. P.C.	.694 DIA. P.C.
AB	.045 DIA.	.053 DIA.
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	086
AG	.005 R. MIN. (ALTERNATE TO M&U)	


EIMAC 4X250B
TYPICAL
GROUNDED GRID
CONSTANT CURRENT
CHARACTERISTICS
SCREEN TO GRID VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
CATHODE TO GRID VOLTAGE — VOLTS
-60
-40
-20
0
+ 20
+ 40
+ 60
+ 80
0
400
800
1200
1600
2000
PLATE TO GRID VOLTAGE — VOLTS
300
200
150
100
050
200
100
050
020
0
010
020
1.40
1.00
.600
.400
.200
.100
.050
0
0


EIMAC 4X250B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
400
300
200
.200
.100
.050
.025
.050
.100
.200
0
.010
.025
.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



Printed in U.S.A. 83457

EITEL-McCULLOUGH, INC.

5CX1500A

RADIAL BEAM POWER PENTODE

The Eimac 5CX1500A is a ceramic and metal power pentode designed to be used as a Class-AB_1 linear amplifier in audio or radio-frequency applications. Its characteristic low intermodulation distortion makes it especially suitable for single sideband service. The filament is a rugged mesh type.

The tube is also recommended for use as a Class-C radio-frequency power amplifier, and plate-modulated radio-frequency power amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL	*Min.*	*Nom.*	*Max.*
Filament: Thoriated Tungsten Mesh			
Voltage		5.0	volts
Current		40	amps
Amplification Factor (Grid Screen)		5.5	
Transconductance (at Ib=1.0 amp, Ec_2=500 volts, Eb=2000 volts)			24,000 μmhos
Frequency For Maximum Ratings			110 Mc
Direct Interelectrode Capacitances, Grounded Cathode:			
Input		77	μμf
Output		16	μμf
Feedback		0.11	μμf

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	Eimac SK840 series
Recommended Air Chimney	Eimac SK-806
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	5.0 inches
Diameter	3.4 inches
Cooling	Forced Air
Net Weight	30 ounces
Shipping Weight (Approximate)	3 pounds

(Effective 2-15-65) © Eitel-McCullough, Inc. 1965

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 MAX. VOLTS
DC SCREEN VOLTAGE	750 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMPS
PLATE DISSIPATION	1500 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATON	25 MAX. WATTS
SUPPRESSOR DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	3000	4000	4500 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—200	—200	—200 volts
DC Suppressor Voltage	0	0	0 volts
DC Plate Current	900	800	900 mA
DC Screen Current	94	66	88 mA
DC Grid Current	35	25	34 mA
Peak R-F Grid Voltage	255	245	255 volts
Driving Power	9	6.5	9 watts
Plate Output Power	1980	2350	3180 watts
Plate Dissipation	720	850	870 watts
Resonant Load Impedance	1570	2240	2520 ohms

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3500 MAX. VOLTS
DC SCREEN VOLTAGE	550 MAX. VOLTS
DC PLATE CURRENT	0.8 MAX. AMPS
PLATE DISSIPATION*	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATON	25 MAX. WATTS
SUPPRESSOR DISSIPATION	25 MAX. WATTS

*Corresponds to 1500 watts at 100 percent sine-wave modulation

TYPICAL OPERATION

DC Plate Voltage	2500	3200 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	—260	—260 volts
DC Suppressor Voltage	0	0 volts
Peak AF Screen Voltage (For 100% Modulation)	500	500 volts
DC Plate Current	800	800 mA
DC Screen Current	90	86 mA
DC Grid Current	32	32 mA
Peak R-F Grid Voltage	315	315 volts
Grid Driving Power	10	10 watts
Plate Dissipation	530	576 watts
Plate Outut Power	1470	1958 watts
Resonant Load Impedance	1360	1863 ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000 MAX. VOLTS
DC SCREEN VOLTAGE	750 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMPS
PLATE DISSIPATION	1500 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATON	25 MAX. WATTS
SUPPRESSOR DISSIPATION	25 MAX. WATTS

*Adjust for Zero-Signal Plate Current
**Per tube

TYPICAL OPERATION (Two Tubes), Class AB_1

DC Plate Voltage	2800	3800 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage*	—81	—83 volts
DC Suppressor Voltage	0	0 volts
Max-Signal Plate Current	1.30	1.33 amps
Zero-Signal Plate Current	0.50	0.50 amps
Max-Signal Screen Current	110	106 mA
Zero-Signal Screen Current	20	20 mA
Peak AF Driving Voltage	81	83 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	4800	6720 ohms
Max-Signal Plate Dissipation**	720	1130 watts
Max-Signal Plate Output Power	2200	3220 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 MAX. VOLTS
DC SCREEN VOLTAGE	750 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMPS
PLATE DISSIPATION	1500 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATON	25 MAX. WATTS
SUPPRESSOR DISSIPATION	25 MAX. WATTS

*Adjust to the specified Zero-Signal Plate Current

**The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies Below 30 Mc)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

DC Plate Voltage	2500	3000	4000 volts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage*	—87	—89	—90 volts
DC Suppressor Voltage	0	0	0 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current	660	690	690 mA
Two-Tone DC Plate Current	468	482	485 mA
Single-Tone DC Screen Current	79	71	59 mA
Two-Tone DC Screen Current	36	32	25 mA
Peak RF Grid Voltage	87	89	90 volts
Driving Power	0	0	0 watts
Useful Output Power	1090	1330	1785 watts
Resonant Load Impedance	2340	2680	3500 ohms
Intermodulation Distortion Products**			
3rd Order	—38	—36	—33 db
5th Order	—39	—41	—42 db

APPLICATION

MECHANICAL

Mounting

The 5CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket

The Eimac SK-840 socket and SK-806 chimney have been designed especially for the 5CX1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and through the anode cooling fins.

Cooling

The maximum temperature rating for the anode core of the 5CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SEA LEVEL		6000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	27	.33	33	.40
1500	47	.76	58	.95

*Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen-plus-suppressor dissipation can, under some conditions, represent another 125 watts, allowance has been made in preparing this tabulation for an additional 325 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation

The rated filament voltage for the 5CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value or below to obtain maximum tube life.

Intermodulation Distortion

The Radio Frequency Linear Amplifier operating conditions including distorton data are the results of actual operation in a neutralized, grid-driven amplifier. Plots of IM distortion versus power output under two-tone condition for a typical tube are shown on the next page.

Control Grid Operation

The rated dissipation of the grid is 25 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

Screen Grid Operation

The power dissipated by the screen of the 5CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon RMS screen current and voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

Suppressor Grid

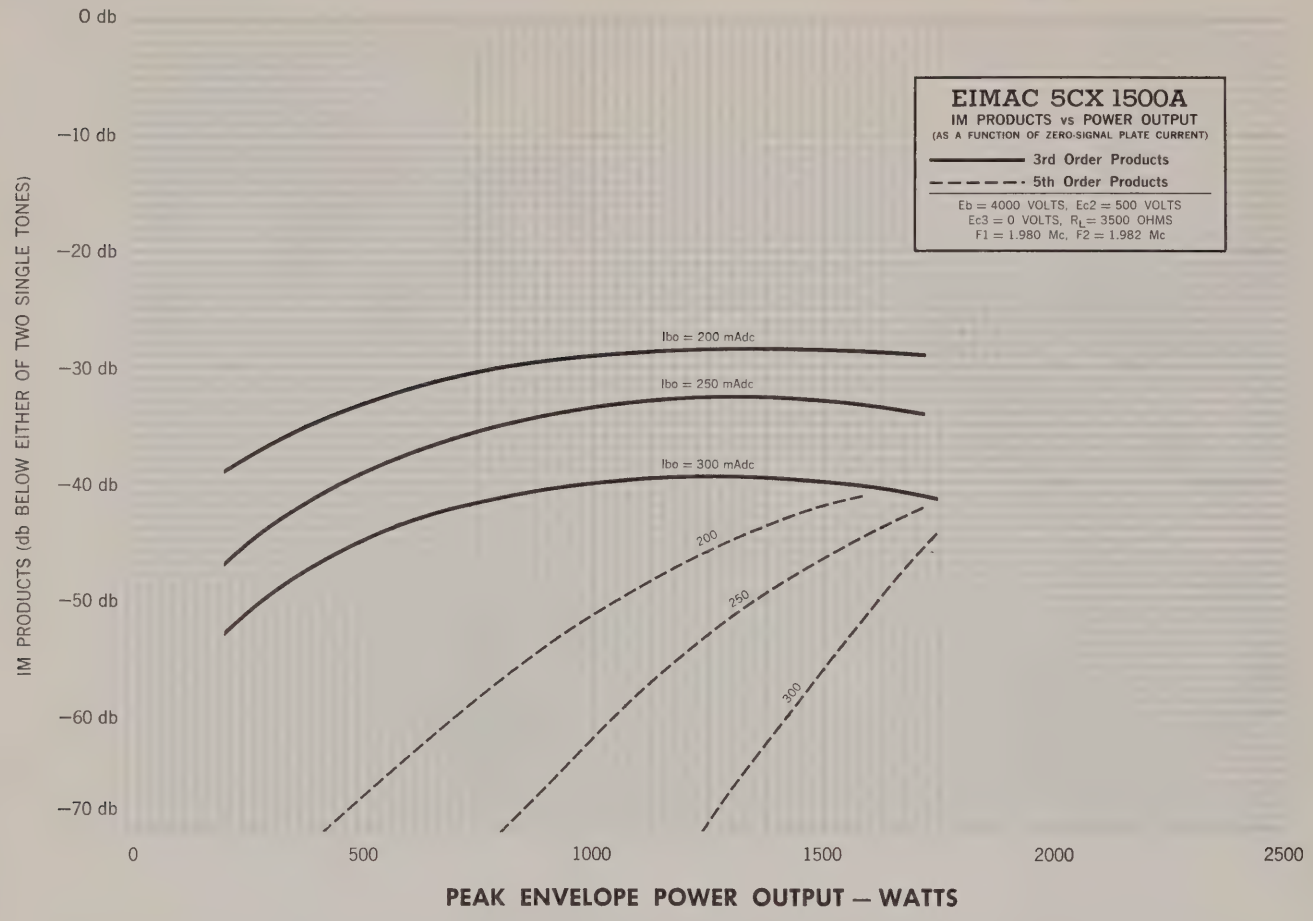
The rated dissipation of the suppressor grid is 25 watts. Suppressor current will be zero or very nearly zero for all typical operating conditions specified. The 5CX1500A has been designed for zero voltage operation of the suppressor grid for most applications.

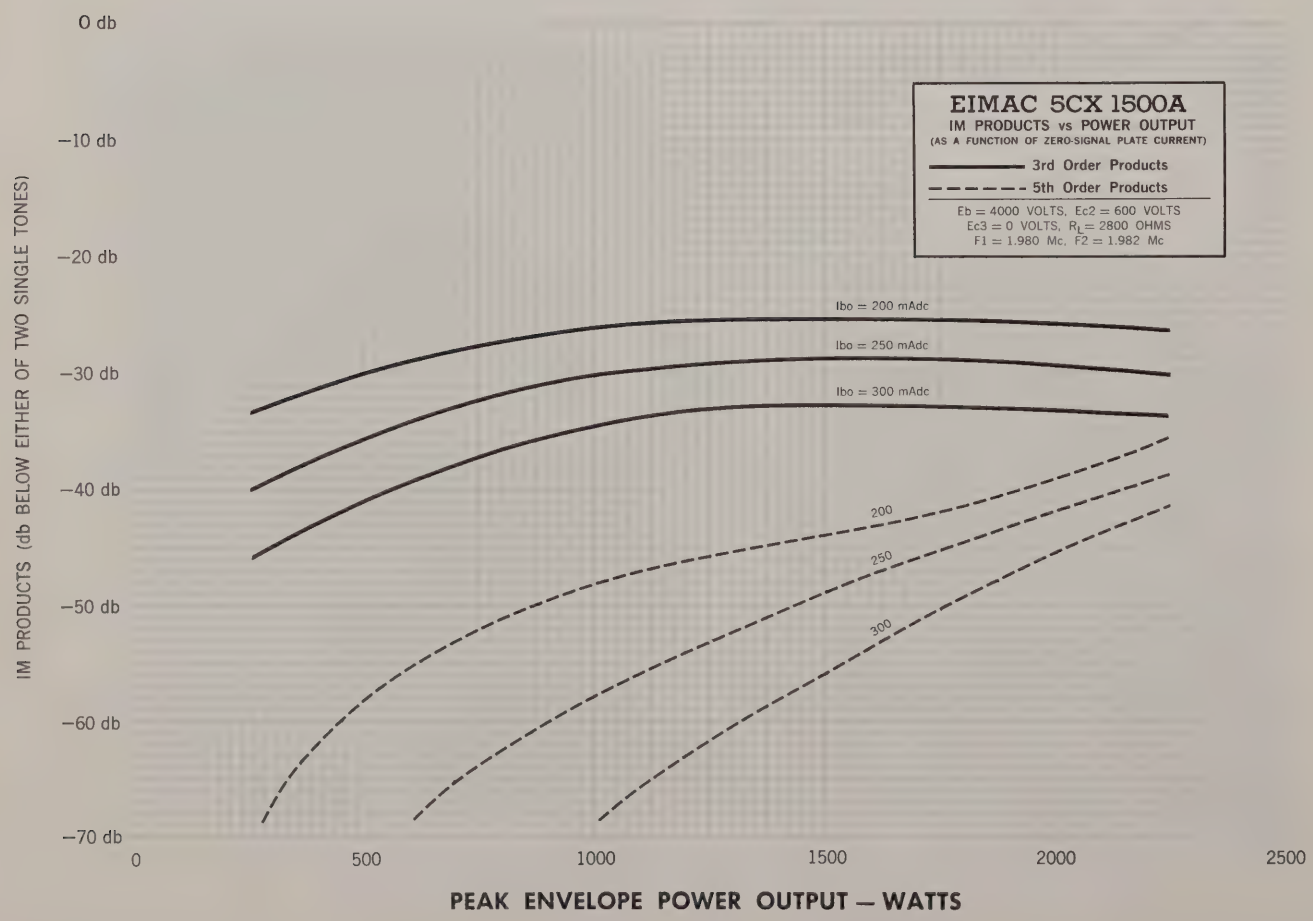
Plate Dissipation

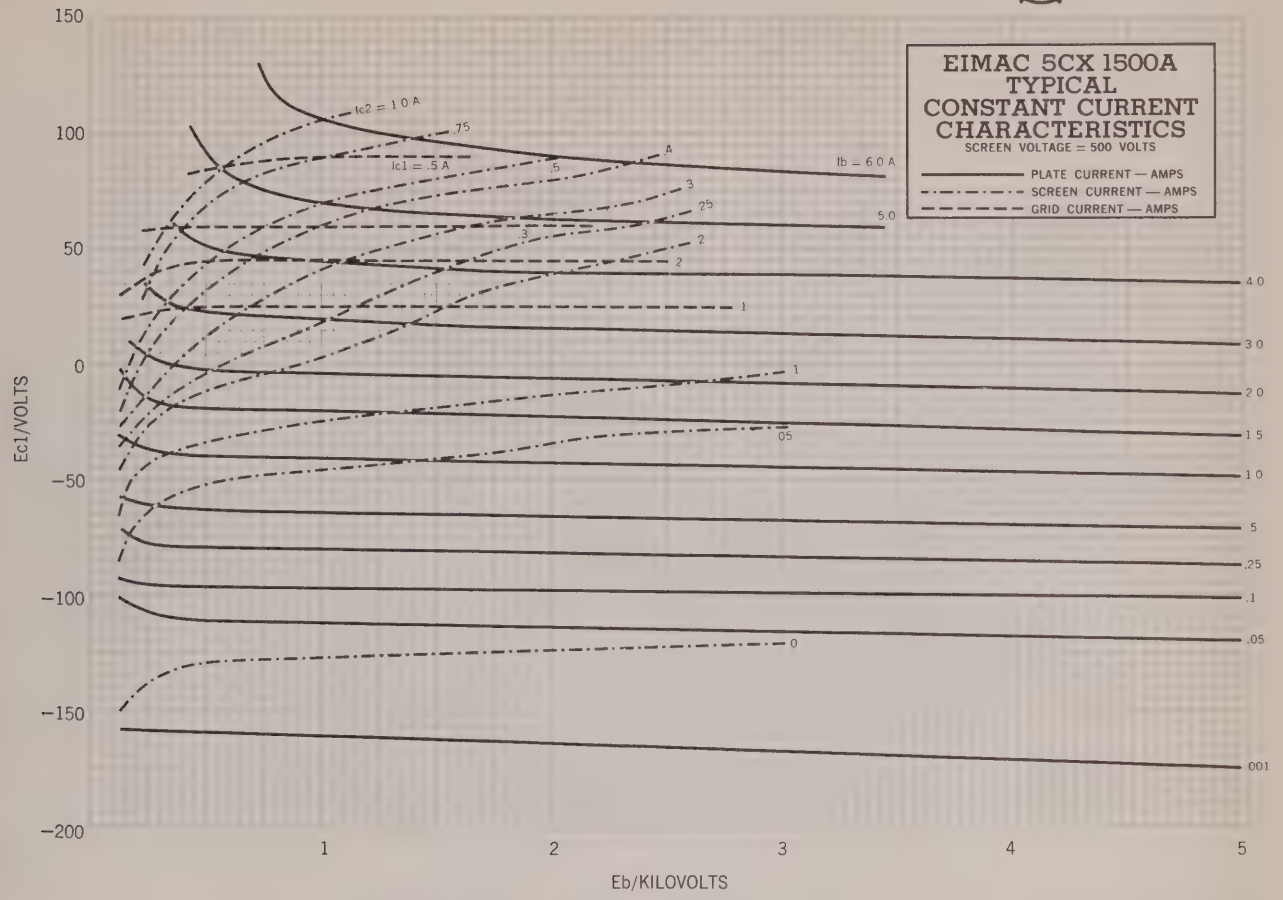
The plate-dissipation ratings for the 5CX-1500A is 1000 watts for Class-C plate-modulated service and 1500 watts for Class-C telegraphy. In Class-AB service the plate dissipation rating is 1500 watts.

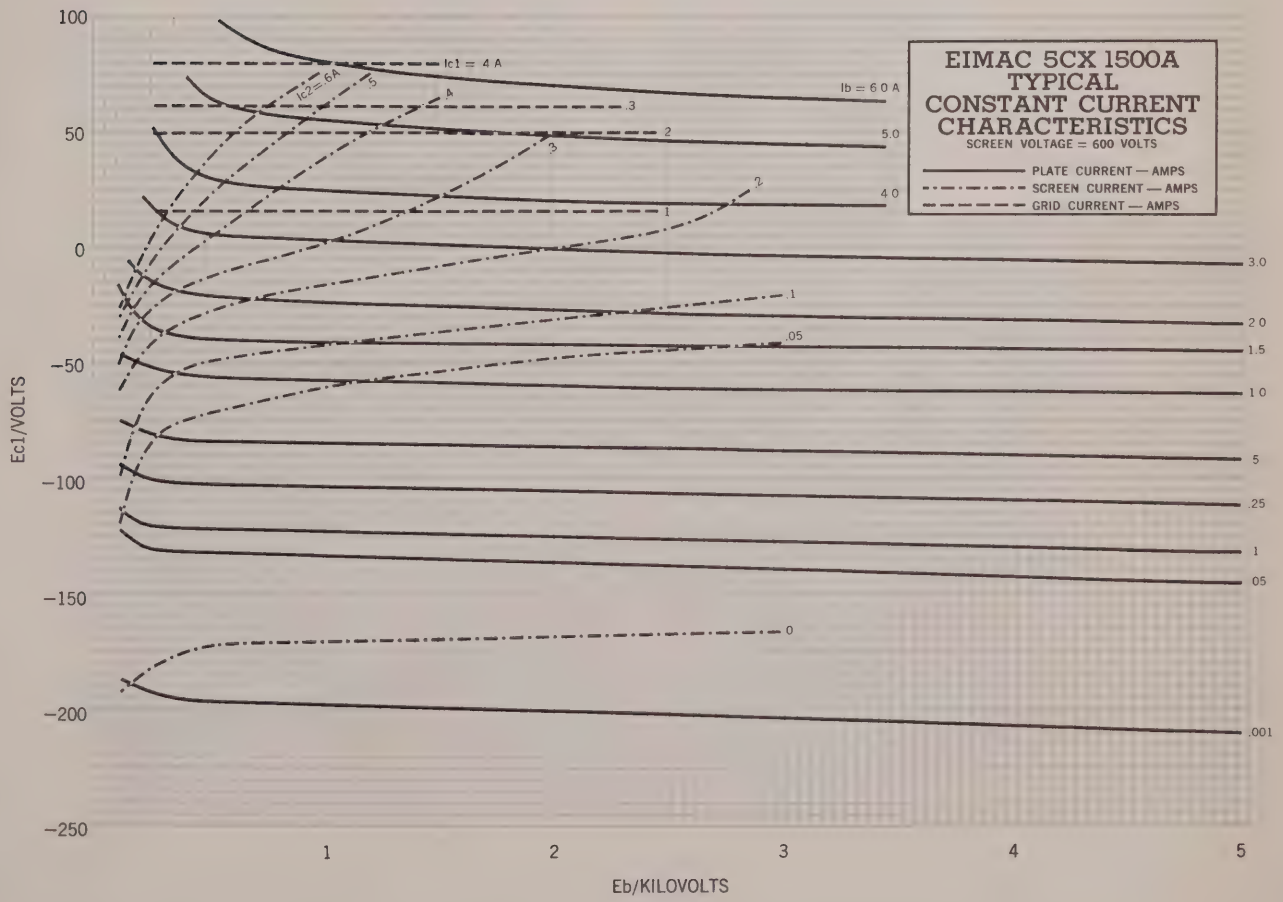
Special Applications

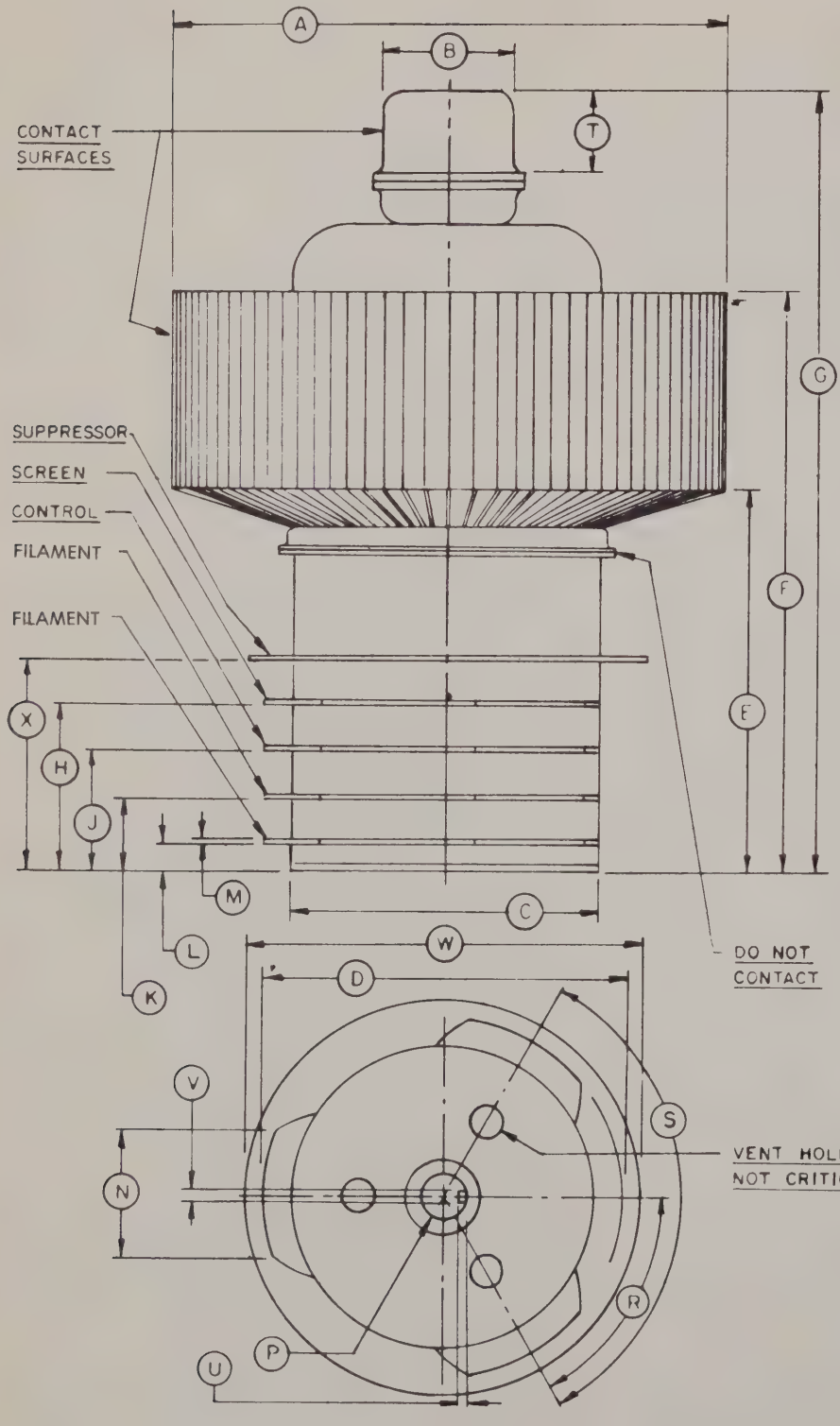
If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Division, Eitel-McCullough, Inc. 301 Industrial Way, San Carlos, California, for information and recommendations.


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 500 VOLTS
Ec3 = 0 VOLTS, RL = 3500 OHMS
F1 = 1.980 Mc, F2 = 1.982 Mc
Ibo = 200 mAdc
Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
0
500
1000
1500
2000
2500
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT — WATTS


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 600 VOLTS
Ec3 = 0 VOLTS, RL = 2800 OHMS
F1 = 1.980 Mc, F2 = 1.982 Mc
Ibo = 200 mAdc
Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
0
500
1000
1500
2000
2500
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
PEAK ENVELOPE POWER OUTPUT — WATTS


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ec1/VOLTS
Eb/KILOVOLTS
Ic2 = 1 0 A
Ic1 = .5 A
Ib = 6 0 A
5.0
4 0
3 0
2 0
1 5
1 0
5
.25
.1
.05
.001
.75
.5
.4
.3
.25
.2
.1
.05
0


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 600 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ec1/VOLTS
Eb/KILOVOLTS
Ic1 = 4 A
Ic2 = 6A
Ib = 6 0 A
5.0
4 0
3.0
2 0
1.5
1 0
5
.25
1
.05
.001
.5
.4
.3
.2
.1
.05
0



DIMENSIONAL DATA			
DIM	MIN	MAX	REF.
A	3.335	3.370	
B	.807	.820	
G	1.870	1.900	
D	2.250 DIA	2.300 DIA	
E	2.335	2.535	
F	3.530	3.730	
G	4.800	4.950	
H	.950	1.000	
J	.675	.725	
K	.400	.450	
L	.140	.170	
M	.020	.030	
N	.700	.800	
P	.314 DIA	.326 DIA	
R	55°	65°	
S	115°	125°	
T	.470	.530	
U	.025	.048	
V	.045 DIA	.070 DIA	
W	2.468	2.531	
X	1.225	1.275	

NOTE:
REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES

EITEL-McCULLOUGH, INC.

EIMAC and EIA TUBE NUMBER CROSS REFERENCE SHEET

May, 1965

Eimac No.	EIA No.
3-200A3	592
3-400Z	8163
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3W5000A1	8240
3W5000F1	8241
3W5000A3	8242
3W5000F3	8243
3X2500A3	8161
3X2500F3	8251
3X3000A1	8238
3X3000F1	8239
3X3000F7	8162
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-1000A	8166
4CPX250K	8590
4CV100,000C	8351
4CW2000A	8244
4CW50,000C	8350
4CX250B	7203
4CX250F	7204
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX1000A	8168
4CX1000K	8352
4CX3000A	8169
4CX5000A	8170
4CX5000R	8170W
4CX10,000D	8171
4CX15,000A	8281
4CX35,000C	8349
4PR60B	8252
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X150R	8296
4X150S	8297
5-125B	4E27A

EIA No.	Eimac No.
4D21	4-125A
4E27A	5-125B
5D22	4-250A
592	3-200A3
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7289	3CX100A5
7580W	4CX250R
7815	3CPN10A5
7815R	3CPX100A5
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3X2500A3
8162	3X3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3X3000A1
8239	3X3000F1
8240	3W5000A1
8241	3W5000F1
8242	3W5000A3
8243	3W5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3X2500F3
8252	4PR60B
8281	4CX15,000A
8283	3CX1000A7
8296	4X150R
8297	4X150S
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8350	4CW50,000C
8351	4CV100,000C
8352	4CX1000K
8438	4-400A
8561	4CX300Y
8590	4CPX250K

8351

4CV100,000C

VAPOR COOLED

POWER TETRODE

The Eimac 8351/4CV100,000C is a ceramic-metal, vapor-cooled power tetrode intended for use at the 100 to 200 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The 8351/4CV100,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The vapor-cooled anode is rated at 100 kilowatts of plate dissipation when mounted in the Eimac BR-300 series boiler.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage		10 volts
Current		300 amps
Amplification Factor (Grid-Screen) (average)		4.5
Interelectrode Capacitances, Grounded Cathode	*Min.*	*Max.*
Input	420	500 μμf
Output	46	56 μμf
Feedback	1.5	3.2 μμf
Interelectrode Capacitances, Grounded Grid		
Input	170	210 μμf
Output	48	58 μμf
Feedback	——	0.6 μμf
Frequency for Maximum Ratings		30 Mc

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250°C
Maximum Anode Flange Temperature	130°C
Recommended Socket	Eimac SK-1500 Series
Recommended Boiler	Eimac BR-300 Series
Operating Position	Vertical, base up
Maximum Dimensions:	
Height	17.0 inches
Diameter	10.0 inches
Cooling	Liquid to vapor and forced air
Net Weight	95 pounds
Shipping Weight (approximate)	150 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	100,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSPATION	500 MAX. WATTS

*Calculated low frequency drive power

▶ TYPICAL OPERATION (Frequencies below 30 megacycles)

DC Plate Voltage	15	17.5 kV
DC Screen Voltage	1.5	1.5 kV
DC Grid Voltage	—1020	—1050 volts
DC Plate Current	11.8	11.8 amps
DC Screen Current	1.0	1.0 amps
DC Grid Current	100	100 mA
Peak RF Grid Voltage	1220	1250 volts
Driving Power*	120	125 watts
Plate Dissipation	38	38.5 kW
Plate Output Power	139	168 kW
Resonant Load Impedance	600	710 ohms

(Effective 3-15-65) © Copyright 1963 by Eitel-McCullough, Inc.

▶ Indicates change from data sheet dated 10-18-62

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class-C Telephony (Carrier conditions except where noted)

▶MAXIMUM RATINGS

DC PLATE VOLTAGE	17,500 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION*	66,500 MAX. WATTS
SCREEN DISSIPATION‡	1750 MAX. WATTS
GRID DISSIPATION‡	500 MAX. WATTS

*Corresponds to 100,000 watts at 100 per cent sine wave modulation

**Approximate value

†Calculated low frequency drive power

‡Average, with or without modulation

▶TYPICAL OPERATION (Frequencies below 30 megacycles)

DC Plate Voltage	14	16 kV
DC Screen Voltage	750	750 volts
Peak AF Screen Voltage (For 100% modulation)**	750	750 volts
DC Grid Voltage	—700	—740 volts
DC Plate Current	9.1	10.0 amps
DC Screen Current	2.0	1.48 amps
DC Grid Current	1.0	0.82 amps
Peak RF Grid Voltage	1000	1060 volts
Grid Driving Power†	1000	870 watts
Plate Dissipation	20.4	21.5 kW
Plate Output Power	107	138.5 kW
Resonant Load Impedance	790	810 ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	100,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Per Tube

**Approximate value

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	15	18 kV
DC Screen Voltage	1.5	1.5 kV
DC Grid Voltage	—360	—380 volts
Max-Signal Plate Current	18.8	20.0 amps
Zero-Signal Plate Current	6.0	6.0 amps
Max-Signal Screen Current**	0.690	0.700 amps
Peak AF Driving Voltage*	350	380 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	1800	2080 ohms
Max-Signal Plate Dissipation*	47.3	56.8 kW
Max. Signal Plate Output Power	187.4	246.4 kW

▶PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER-CATHODE DRIVEN

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	17,500 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	66,500 MAX. WATTS
SCREEN DISSIPATION‡	1750 MAX. WATTS
GRID DISSIPATION‡	500 MAX. WATTS

*Voltages given are referenced to ground

‡Average, with or without modulation

TYPICAL OPERATION (Frequencies below 30 megacycles)

DC Plate Voltage*	12	15 kV
DC Screen Voltage*	560	900 volts
DC Grid Voltage*	—440	—600 volts
DC Plate Current	12.4	11.6 amps
DC Screen Current	1.32	0.72 amps
DC Grid Current	0.20	0.10 amps
Peak RF Cathode Voltage	655	720 volts
Cathode Driving Power	8.1	8.1 kW
Cathode Driving Impedance	27	32 ohms
Plate Dissipation	49.2	47.0 kW
Plate Output Power	112.7	141.0 kW
Resonant Load Impedance	480	650 ohms

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	100,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Approximate value

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

DC Plate Voltage	15	18 kV
DC Screen Voltage	1.5	1.5 kV
DC Grid Voltage	—360	—380 volts
Max-Signal Plate Current	9.4	10.0 amps
Zero-Signal Plate Current	3.0	3.0 amps
Max-Signal Screen Current*	0.345	0.350 amps
Peak RF Grid Voltage	350	380 volts
Driving Power	0	0 watts
Plate Dissipation	47.3	56.8 kW
Plate Output Power	93.7	123.2 kW
Resonant Load Impedance	900	1040 ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

▶Indicates change from data sheet dated 10-18-62

APPLICATION

MECHANICAL

Mounting

The 4CV100,000C must be mounted vertically, anode down, in an Eimac BR-300 series boiler. Care must be exercised to insure that the axis of the tube/boiler combination is vertical and that water in the boiler is at the level indicated. The anode flange on the tube must seat securely against the rubber "O" ring, forming a vapor-tight seal between tube and boiler.

Socket

The Eimac SK-1500 series socket is available for use with the 4CV100,000C. Filament, control grid and screen grid connections are made to this socket. Spring finger contacts on the socket are used to make connections to the concentric rings on the tube base.

Cooling

Cooling is accomplished by immersing the anode of the 4CV100,000C in a "Boiler" filled with distilled water. Energy dissipated by the anode causes the water to boil at the anode surfaces, be converted into steam and be carried away to an external condenser. The condensate is then returned to the boiler, completing the cycle.

This boiling action maintains the anode surfaces at a fairly constant temperature near 100°C. The vapor-cooled tube has good overload capabilities; excess dissipation for moderate periods only causes more water to boil.

The system schematic drawing shown below outlines a vapor-cooling installation. A control box (Eimac CB-202) is used to sense water level, to signal for make-up water and to shut down the system in case of low water level. In order to perform its function, the control box must be mounted so that its water level mark is at the same elevation as the water level mark on the boiler.

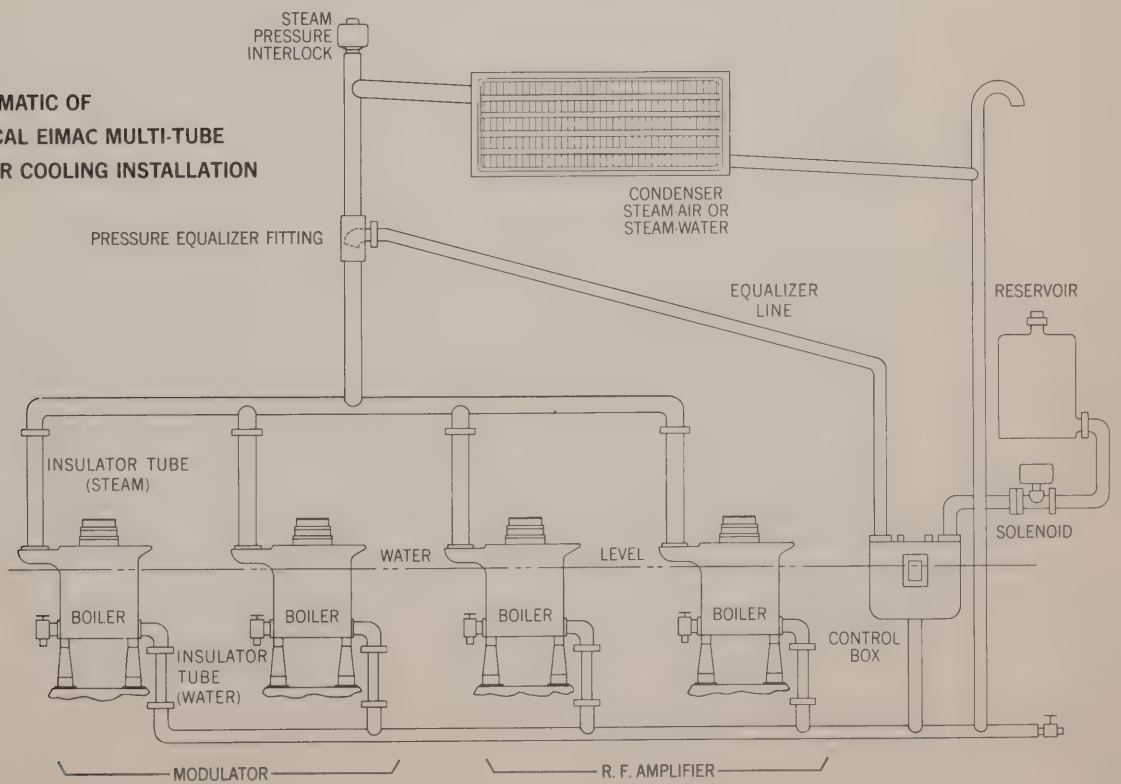
Since the tube anode and boiler are usually at high potential to ground, water and steam connections to the boiler are made through insulating tubing.

A pressure equalizing line is shown between the steam side of the system and the top of the control box. Its function is to provide the same pressure in the control box as in the boiler.

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 C.F.M. of air directed through the center of the socket is sufficient for this purpose.

SCHEMATIC OF TYPICAL EIMAC MULTI-TUBE VAPOR COOLING INSTALLATION



ELECTRICAL

Filament

The rated filament voltage for the 4CV-100,000C is 10.0 volts. Filament voltage, as measured at the socket, should be maintained at 10 volts plus or minus five percent to obtain maximum life and consistent performance.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of either tube, or SK-1500 socket, must not exceed 100 volts.

Control-Grid Operation

The 4CV100,000C control grid is rated at 500 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

Screen Dissipation

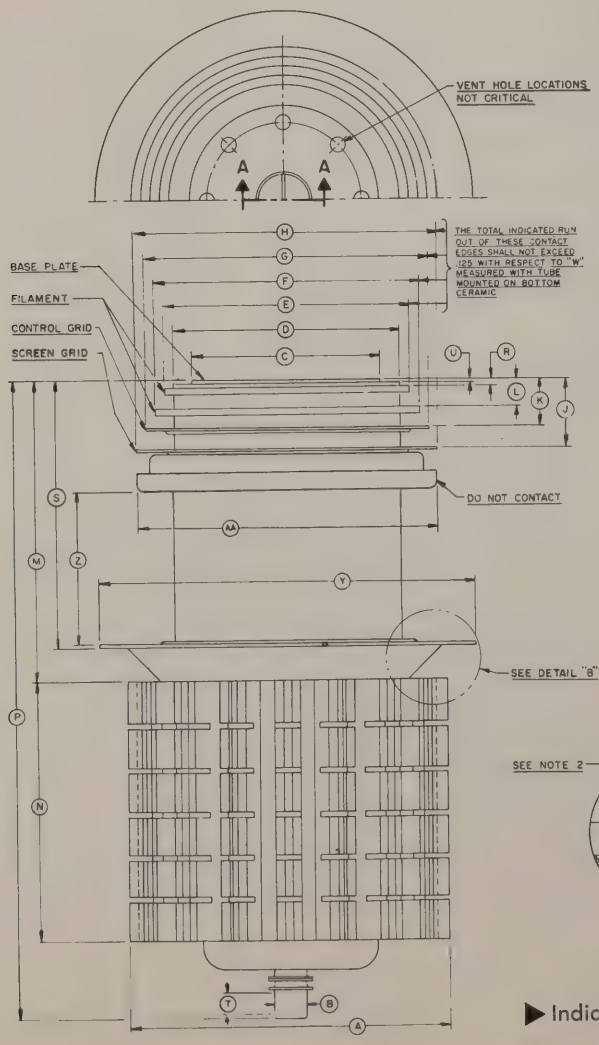
The power dissipated by the screen grid must not exceed 1750 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on RMS screen voltage, and RMS screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

Plate Dissipation

The plate dissipation of 100 kilowatts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV100,000C is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 66,500 watts.

Special Application

Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



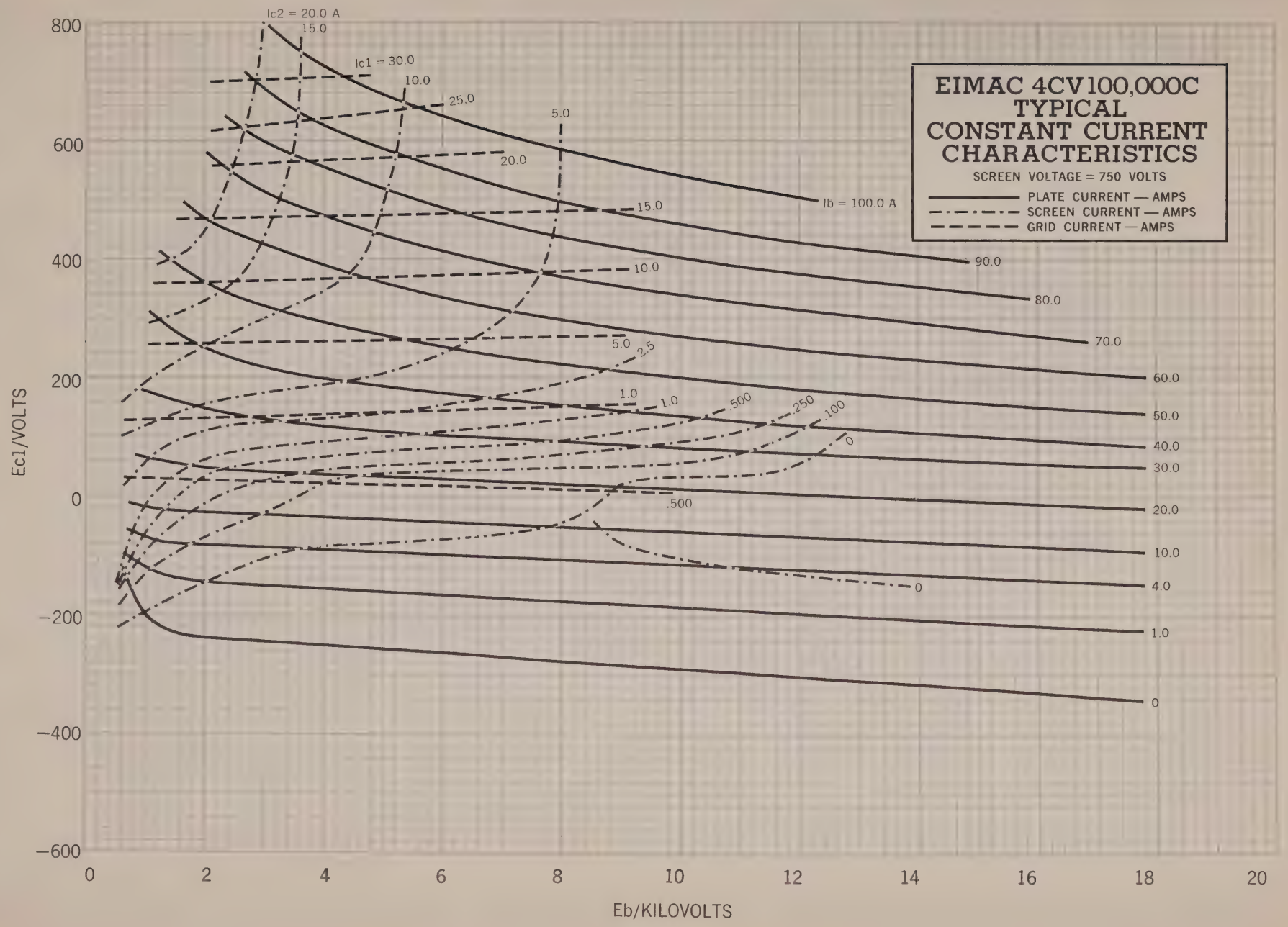
DIMENSIONS IN INCHES

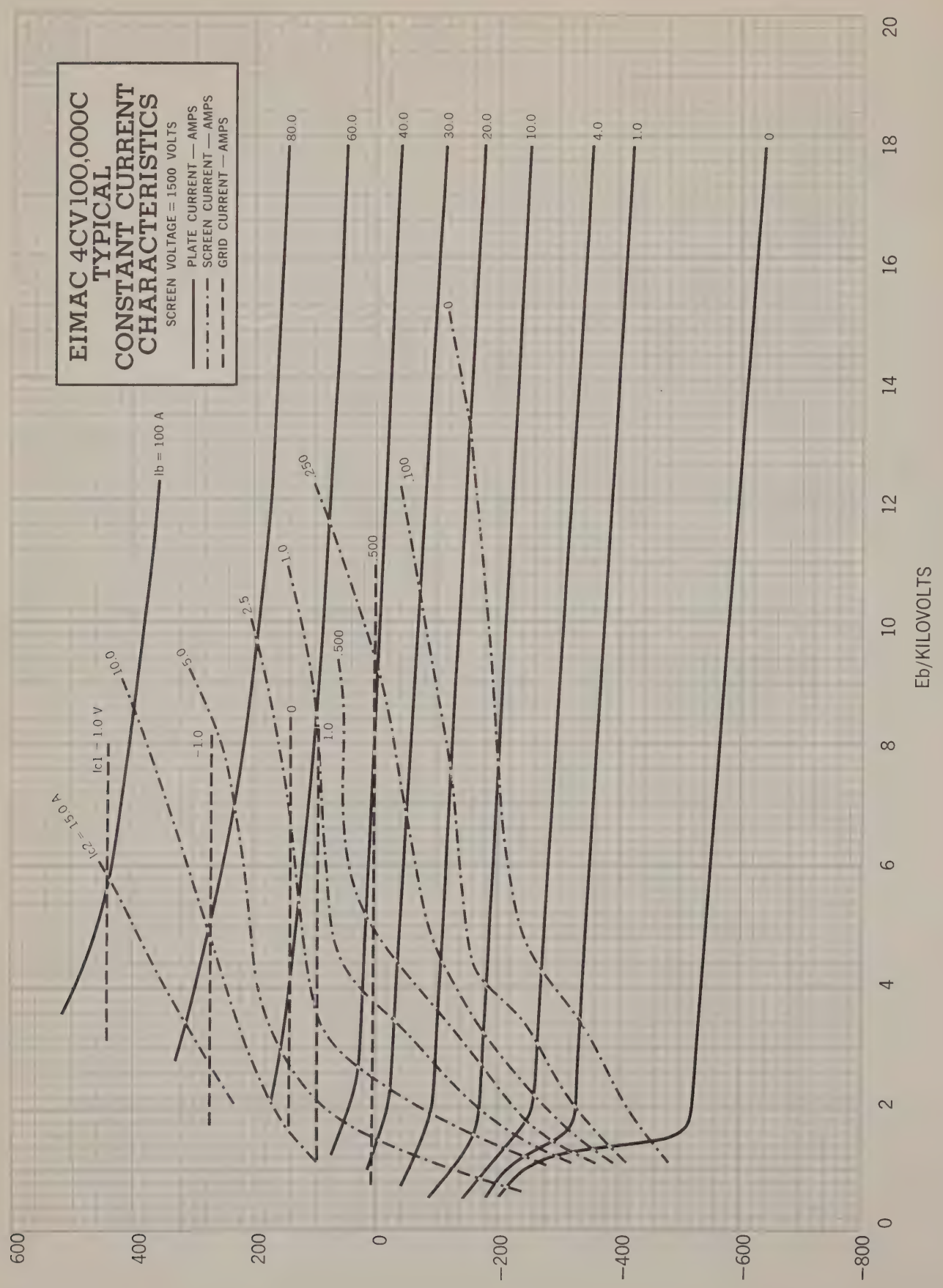
DIMENSIONAL DATA

DIM	MIN.	MAX.	REF.
A	8.400	8.650	
B	.860	.890	
C	4.980	5.020	
D	5.980	6.020	
E	6.510	6.560	
F	6.980	7.020	
G	7.480	7.520	
H	7.975	8.015	
J	1.750	1.800	
K	1.220	1.270	
L	.690	.740	
M	7.890	8.140	
N	6.690	6.940	
P	16.840	17.240	
R	.173	.213	
S	7.010	7.265	
T	.485	.515	
U	.045	.075	
V		.135	
W	1.250	1.270	
X	.490	.530	
Y	9.900	10.100	
Z	3.850	–	
AA	7.875	8.125	

NOTES:
1. AREA FOR MEASURING ANODE FLANGE TEMPERATURE.
2. SILICONE RUBBER INSULATION.
3. 1/4" CROSS SECTION X 9-1/2" O.D. "O" RING IS SUPPLIED WITH TUBE.
4. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

▶ Indicates change from data sheet dated 10-18-62


EIMAC 4CV100,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ic2 = 20.0 A
15.0
Ic1 = 30.0
10.0
25.0
5.0
20.0
15.0
Ib = 100.0 A
90.0
10.0
80.0
70.0
5.0
2.5
60.0
1.0
1.0
.500
.250
.100
0
50.0
40.0
30.0
.500
20.0
10.0
0
4.0
1.0
0
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
Ec1/VOLTS
Eb/KILOVOLTS


EIMAC 4CV100,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ib = 100 A
Ic1 = 15.0 A
Ic2
Ic1 = 1.0 V
10.0
5.0
2.5
1.0
0
-1.0
80.0
60.0
40.0
30.0
20.0
10.0
4.0
1.0
0
250
100
500
1.0
500
0
Eb/KILOVOLTS
Ec1/VOLTS
0
2
4
6
8
10
12
14
16
18
20
600
400
200
0
-200
-400
-600
-800



EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

EIMAC and EIA

POWER GRID TUBE NUMBER CROSS-REFERENCE LIST

EIMAC to EIA

Eimac No.	*EIA No.*
KY21A	——
RX21A	——
2-01C	——
2-25A	——
2-50A	——
2-150D	——
2-240A	——
2-450A	——
2-2000A	——
2C39A	2C39A
2C39WA	2C39WA
2X1000A	——
2X3000F	——
322	——
3C24	3C24
3-200A3	592
3-400Z	8163
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV30,000A1	——
3CV30,000A3	——
3CW20,000A1	——
3CW20,000A3	——
3CW20,000A7	——
3CW20,000H3	——
3CW25,000A3	——
3CW30,000H3	——
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX2500A3	8161
3CX2500F3	8251
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX15,000A3	——
3W5000A1	8240
3W5000F1	8241
3W5000A3	8242
3W5000F3	8243
3X3000A1	8238

Eimac No.	*EIA No.*
3X3000A7	——
3X3000F1	8239
3X3000F7	8162
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-1000A	8166
4CPX250K	8590
4CS250H	——
4CV8000A	——
4CV20,000A	——
4CV35,000A	——
4CV100,000C	8351
4CW800A	——
4CW2000A	8244
4CW10,000A	——
4CW25,000A	——
4CW50,000C	8350
4CW100,000D	——
4CX125C	——
4CX125F	——
4CX250B	7203
4CX250F	7204
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX600A	——
4CX1000A	8168
4CX1000K	8352
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000R	8170W
4CX10,000D	8171
4CX15,000A	8281
4CX35,000C	8349
4PR60B	8252

Eimac No.	*EIA No.*
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	——
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X150R	8296
4X150S	8297
4X500A	——
5-125B	4E27A
5-500A	——
5CX1500A	——
5CX3000A	——
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250R	——
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
750TL	750TL
1000T	1000T
1500T	1500T
2000T	2000T

NUMBER CROSS-REFERENCE LIST

EIA to EIMAC

EIA No.	*Eimac No.*
2C39A	2C39A
2C39WA	2C39WA
4D21	4-125A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	——
592	3-200A3
673	——
750TL	750TL
869B	——
869B/L	——
1000T	1000T
1500T	1500T
2000T	2000T
5867A	——
6696A	——

EIA No.	*Eimac No.*
6697A	——
6884	——
6894	——
6895	——
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	——
7289	3CX100A5
7480	——
7580W	4CX250R
7698	——
7815	3CPN10A5
7815R	3CPX100A5
7843	——
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3X3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G

EIA No.	*Eimac No.*
8173	4W20,0000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3X3000A1
8239	3X3000F1
8240	3W5000A1
8241	3W5000F1
8242	3W5000A3
8243	3W5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8281	4CX15,000A
8283	3CX1000A7
8296	4X150R
8297	4X150S
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8350	4CW50,000C
8351	4CV100,000C
8352	4CX1000K
8438	4-400A
8561	4CX300Y
8590	4CPX250K
8660	4CX1500B


Eimac

Eimac®

EIMAC

A Division of Varian Associates

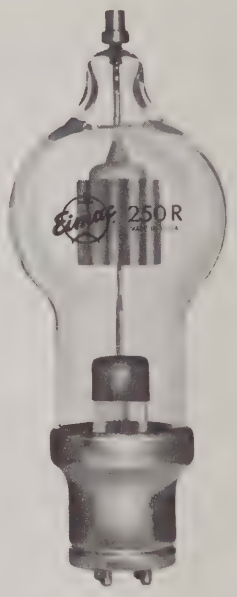
250R

HIGH-VACUUM RECTIFIER

The Eimac 250R is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 250R has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 60,000 volts. Cooling is by convection and radiation.

A single 250R will deliver 160 milliamperes at 24,000 volts to a capacitor-input filter with 21,000 volts single-phase supply. Four 250R's in a bridge circuit will deliver 500 milliamperes at 38,000 volts to a choke-input filter with 42,000 volts single-phase supply.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	10.5 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.82 inches
Net Weight	10 ounces
Shipping Weight (approx.)	3 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	60,000 MAX. VOLTS
PLATE DISSIPATION	150 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application"

APPLICATION

MECHANICAL

Mounting—The 250R must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 250R is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

(Revised 12-15-65) Copyright 1952, 1965 by Varian Associates

APPLICATION (Continued)

225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 250R reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 250R begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 60,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 250R when used as a power-supply rectifier.

250R MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	21,000	24,000	160	. .	..
Single-Phase, Full-Wave	21,000[1]	24,000	320	19,000	500
Single-Phase, Bridge	42,000	48,000	320	38,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 250R is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 250R is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 250R is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 250R when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 250R, which may be taken as 750 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expersssed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 250R is 60,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 250R is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 250R is 400 milliamperes.

The plate characteristic curve for the 250R serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 60,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

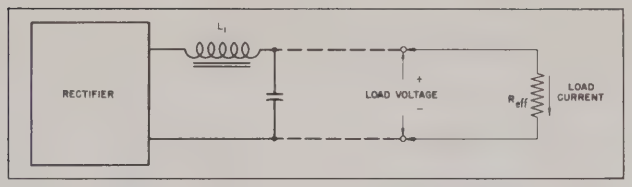
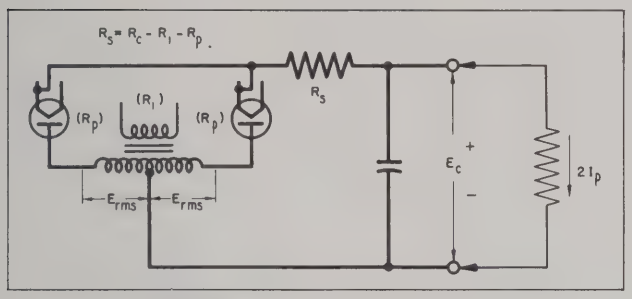
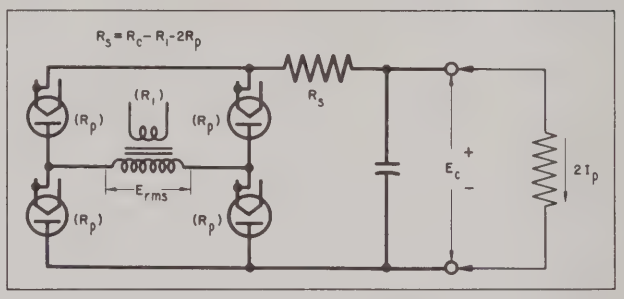


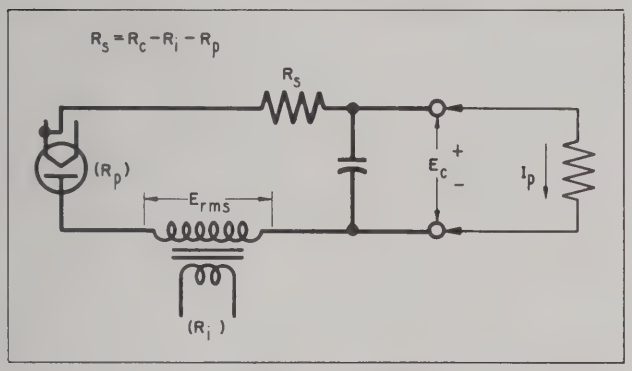
Fig. 1. Rectifier with Choke-Input Filter



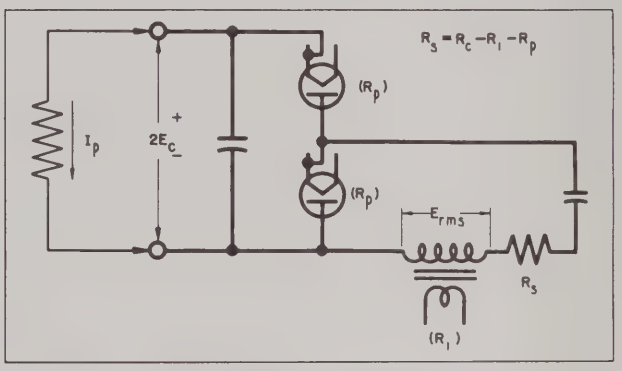
a. Full-Wave Center-Tapped Rectifier



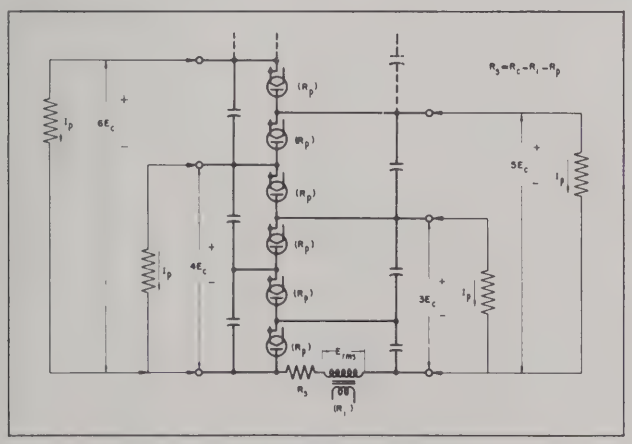
b. Full-Wave Bridge Rectifier



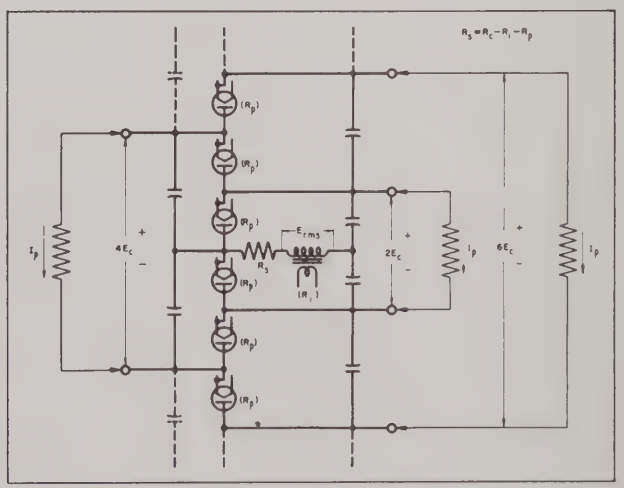
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



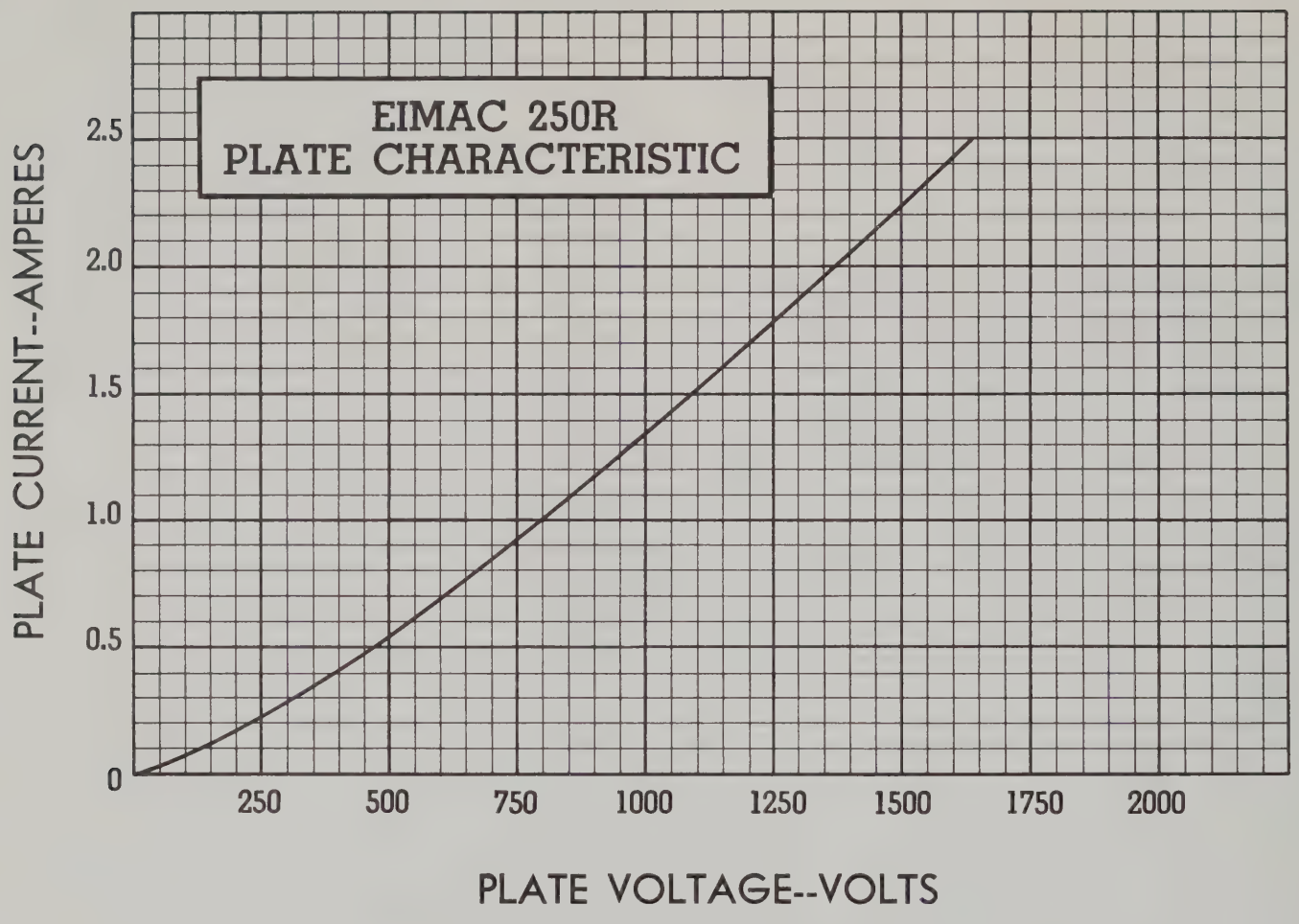
f. Full-Wave Voltage Multiplier

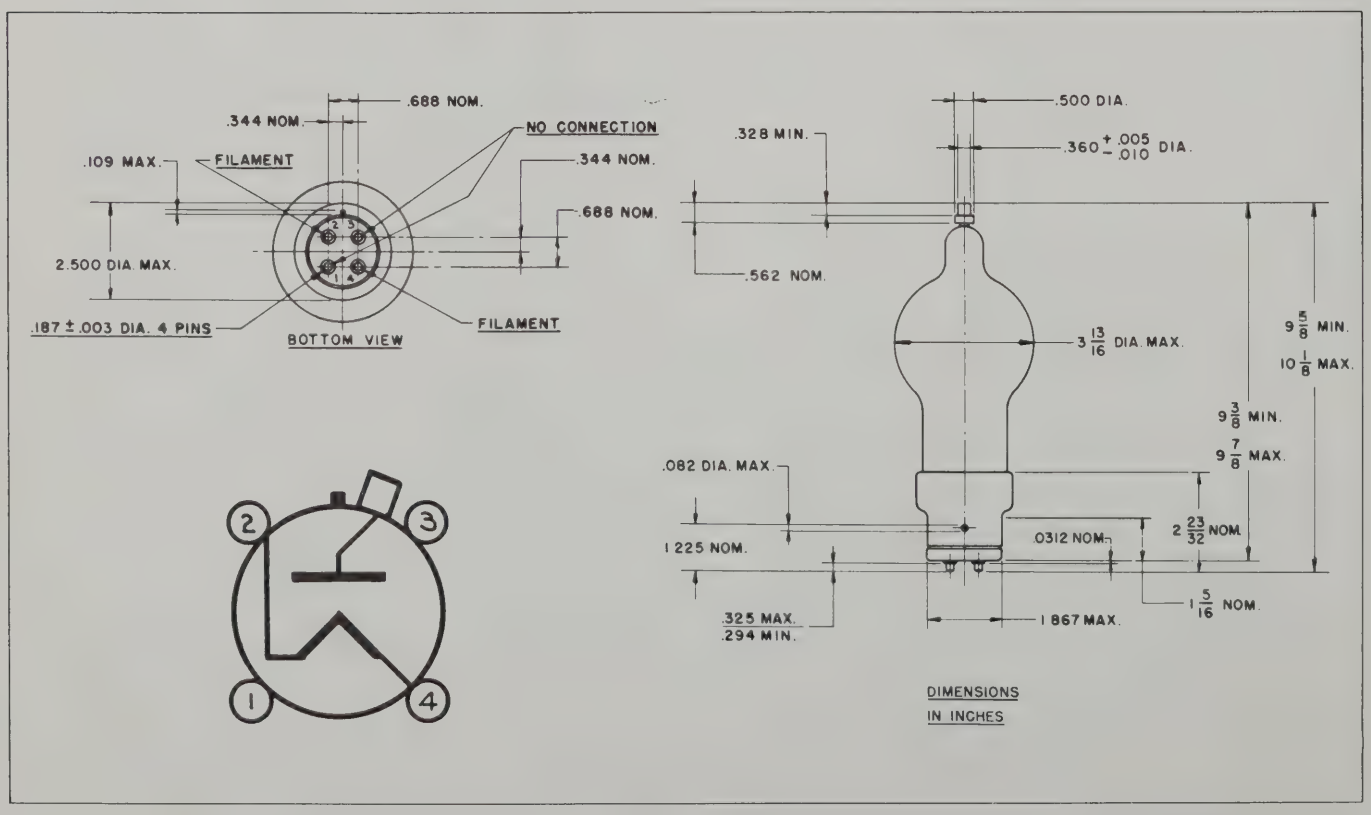
Eimac 250R Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	140	150	160	170	180	190	200	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.2	1.9	3.0	4.8	7.6	12	19	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.87	0.93	1.01	1.14	1.33	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.7	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 250R Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 750 ohms (375 ohms for two tubes in parallel)





Printed in U.S.A. 1012

8189
4PR1000A

RADIAL-BEAM PULSE TETRODE

•

MODULATOR OSCILLATOR AMPLIFIER

EIMAC

A Division of Varian Associates

The Eimac 8189/4PR1000A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-510 Air-System Socket and the SK-506 Air Chimney.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor (Grid to Screen)	-	6.9		
Direct Interelectrode Capacitances, Grounded Cathode:†				
Grid-Plate	-	-	0.35	uuf
Input	23.8		32.4	uuf
Output	6.8		9.4	uuf
Transconductance (I_b=300 ma)	-	10,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-510 Air-System Socket
Operating Position	Vertcial, base down or up
Maximum Operating Temperatures:	
Base Seals	150°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

†In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

D-C PLATE VOLTAGE	30 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK PLATE CURRENT	8.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	20	25	30 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—335	—360	—380 Volts
Pulse Plate Voltage	17.7	22.7	27.7 Kilovolts
Peak Plate Current	8.0	8.0	8.0 Amperes
Pulse Screen Current	1.25	1.25	1.25 Amperes
Pulse Grid Current	0.2	0.2	0.2 Ampere
Pulse Pos. Grid Voltage	200	200	200 Volts
Pulse Drive Power	107	112	116 Watts
Pulse Plate Input Power	160	200	240 Kilowatts
Pulse Plate Output Power	140	180	220 Kilowatts
Duty	4.0	4.0	4.0 Percent

(Effective 12-15-65) Copyright 1962, 1965 by Varian Associates

RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS	
PEAK D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

*When used as a R-F Plate and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

TYPICAL OPERATION			
Pulse Plate Voltage	10	15	20 Kilovolts
Pulse Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—510	—535 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	760	785 Volts
Pulse Drive Power	14.7	15.2	15.7 Watts
Pulse Plate Input Power	19.5	29.3	39.0 Kilowatts
Pulse Plate Output Power	17.0	23.0	31.5 Kilowatts
Duty	15.0	15.0	12.0 Percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	15 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION			
D-C Plate Voltage	10	12.5	15 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—495	—510 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	745	760 Volts
Pulse Drive Power	14.7	15.0	15.2 Watts
Pulse Plate Input Power	19.5	24.4	29.3 Kilowatts
Pulse Plate Output Power	17.0	18.6	23.0 Kilowatts
Duty	15.0	15.0	15.0 Percent

Note 1: The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on an available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation sections refers to the d-c plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting—The 4PR1000A must be operated vertically, base up or down. When the SK-510 Air-System Socket is used in conjunction with the SK-506 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-510 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

COOLING—Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 150° C and 200° C, respectively. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-8 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR1000A is operated at d-c or low frequencies in an Eimac SK-510 Air System Socket, complete with SK-506 Air Chimney and HR-8 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 150° C in 50° C inlet air are tabulated below:

	Sea Level		10,000 Feet	
Ave. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
600	17.0	0.30	24.0	0.45
800	20.0	0.40	28.0	0.56
1000	25.0	0.55	36.0	0.80

When the Eimac 4PR1000A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by r-f charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins,

should be 7.5 volts. Variations in filament voltage must be kept within the range of 7.13 to 7.87 volts.

When the 4PR1000A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 4PR1000A should not be allowed to exceed 1000 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

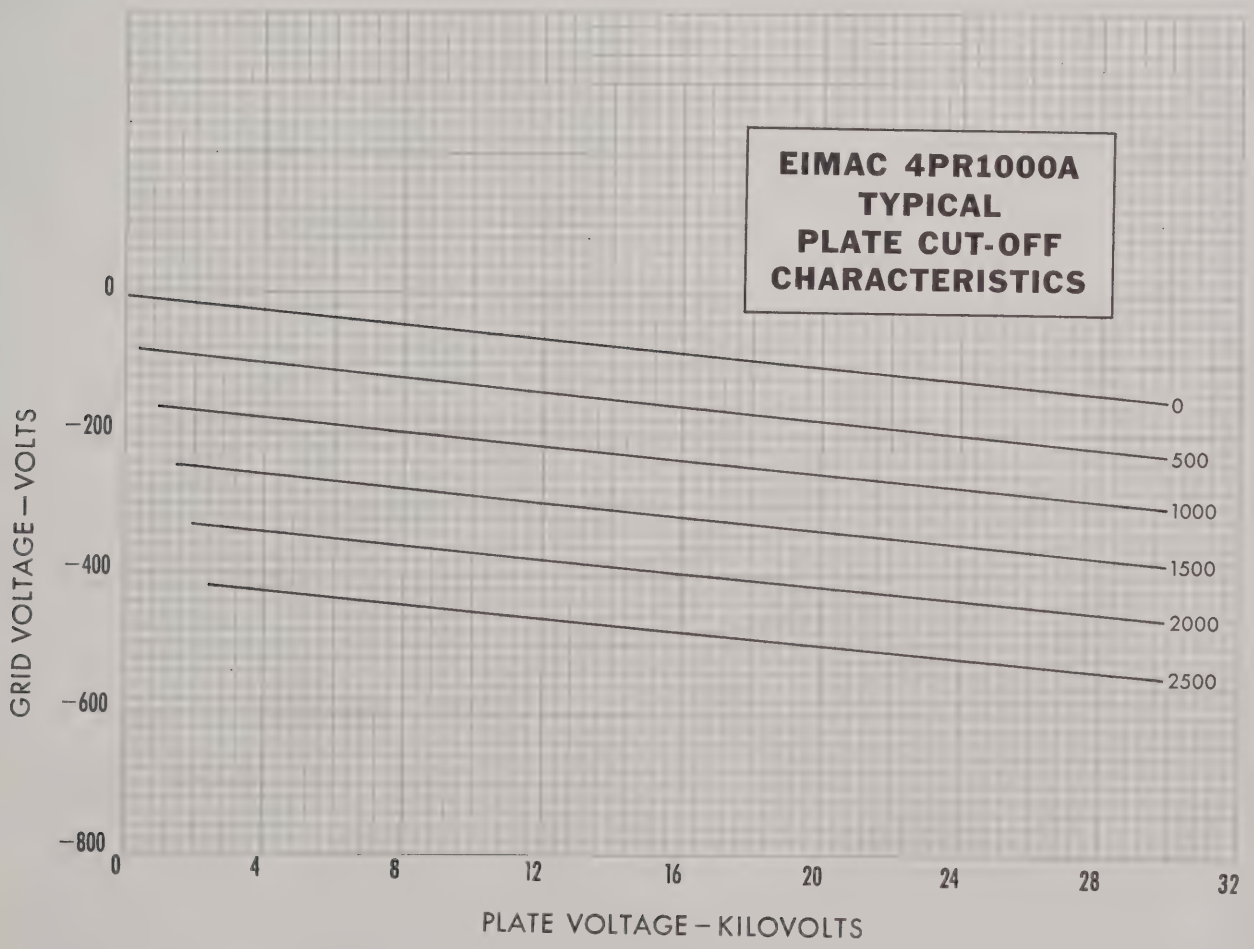
The average power dissipated by the screen-grid and the control-grid must not exceed 75 watts and 25 watts, respectively.

Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 4PR1000A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

Each 4PR1000A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 30 KV, a screen voltage of 2.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 600 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between –470 volts and –585 volts.

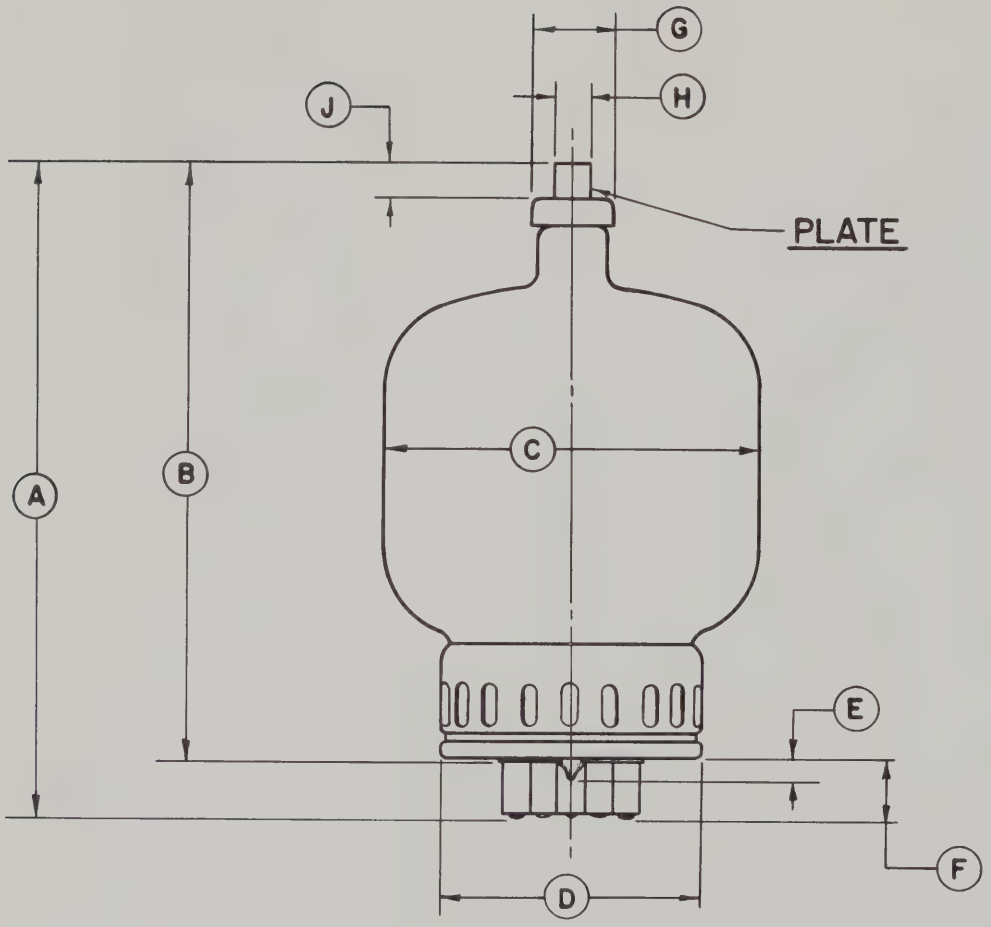
Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate waveform is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

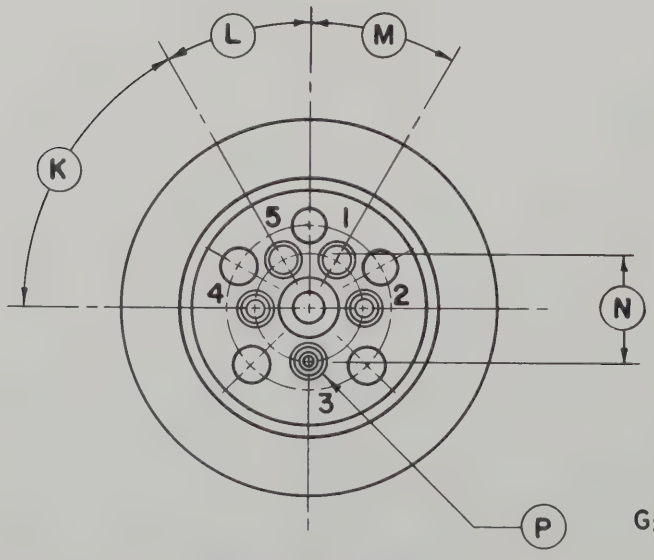
Special Applications — If it is desired to operate this tube under conditions widely different from those given here, please write to Power Grid Tube Marketing, Eimac, a division of Varian Associates, 301 Industrial way, San Carlos, California, for information and recommendations.



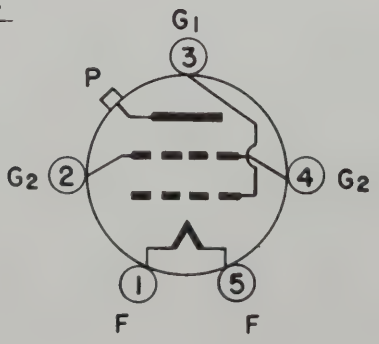
DIMENSIONS IN INCHES

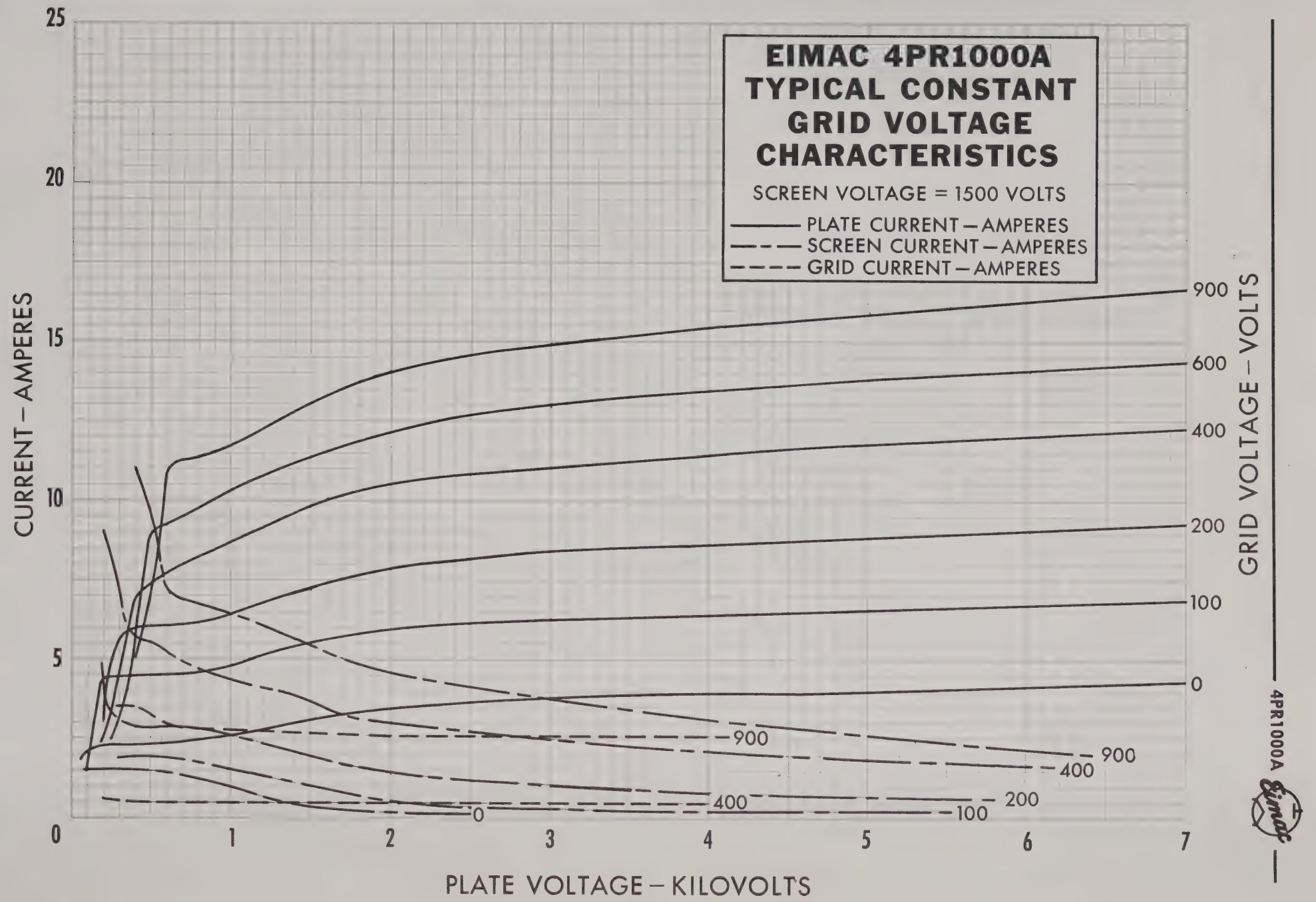
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	8.875	9.625	9.250
B	8.000	8.750	8.375
C		5.250	
D		3.625	
E		.313	
F	.825	.925	.875
G	1.110	1.140	1.250
H	.559	.573	.566
J	.484		
K			60°
L			30°
M			30°
N	1.495	1.505	1.500
P	.371	.377	.374

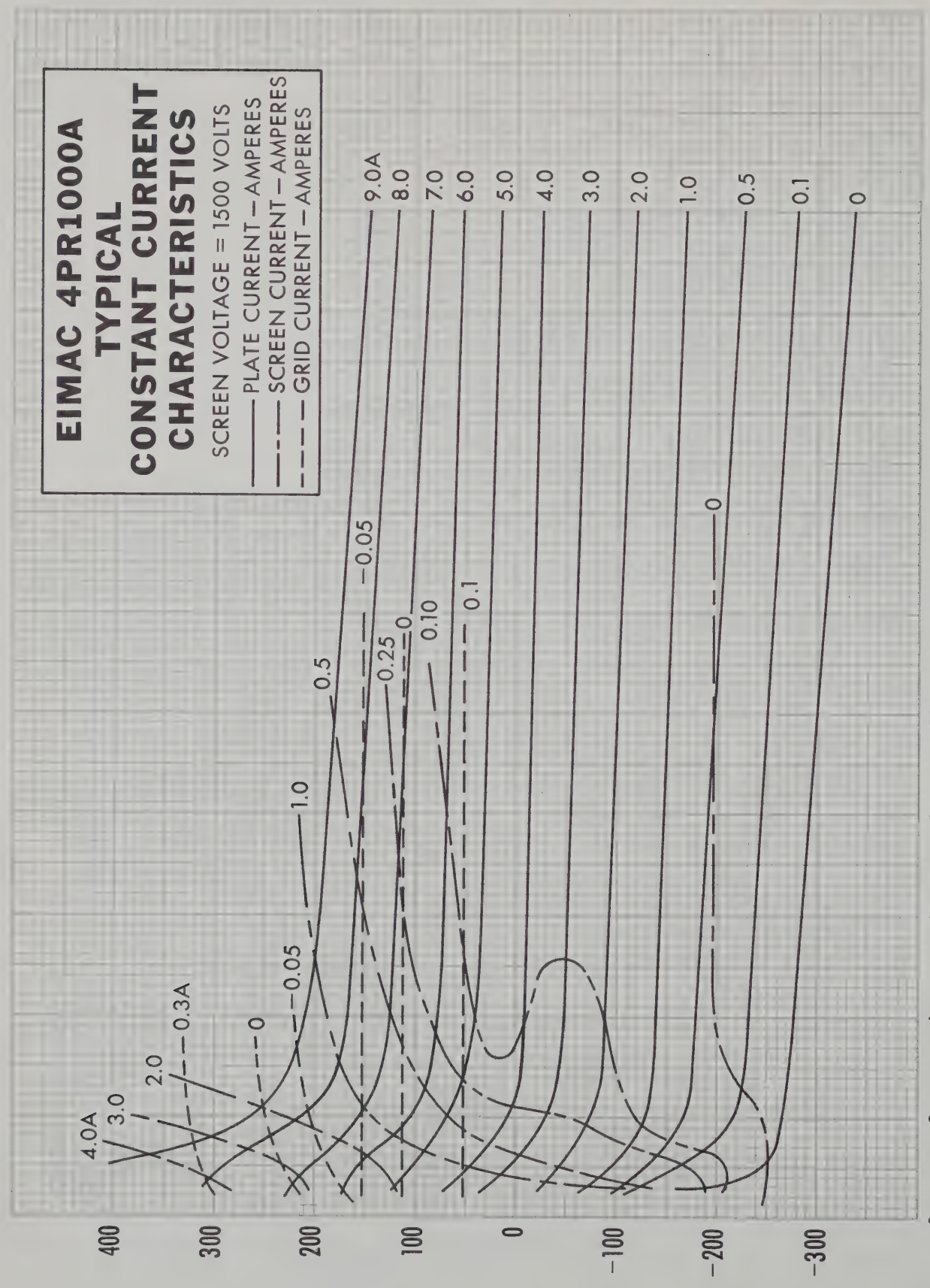




BOTTOM VIEW




EIMAC 4PR1000A
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
CURRENT – AMPERES
PLATE VOLTAGE – KILOVOLTS
GRID VOLTAGE – VOLTS
0
5
10
15
20
25
1
2
3
4
5
6
7
900
600
400
200
100
0
900
400
900
400
200
100
0
4PR1000A
Eimac


EIMAC 4PR1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
9.0A
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
0
4.0A
3.0
2.0
0.3A
0
0.05
1.0
0.5
0.05
0.25
0
0.10
0.1
0
400
300
200
100
0
−100
−200
−300
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS

Eimac®

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

6C21

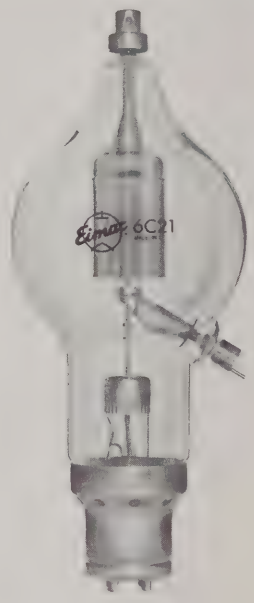
PULSE TRIODE

•

MODULATOR AMPLIFIER

The Eimac 6C21 is a high-vacuum power triode designed for pulse-modulator service at d-c plate voltages up to 30 kilovolts and peak plate currents as high as 15 amperes.

The 6C21 is forced-air and radiation cooled, has a maximum plate-dissipation rating of 300 watts, and, in pulse modulator service, will deliver up to 375 kilowatts to a resistive load with 7.5 kilowatts of driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	8.2 volts
Current	17.0 amperes
Amplification Factor (Average)	30
Direct Interelectrode Capacitances (Average)	
Grid-Plate	4.3 $\mu\mu$f
Input	9.5 $\mu\mu$f
Output	0.7 $\mu\mu$f
Transconductance (I_b=100 ma., E_b=2000v.)	6100 μmhos

MECHANICAL

Base	50-watt jumbo 4-pin
Connections	See drawing
Socket	E. F. Johnson Co. 123-211, National Co. XM-50 or equivalent.
Mounting Position	Vertical, base down or up
Cooling	Forced Air and Radiation
Maximum Temperature of Grid & Plate Seals	225° C.
Recommended Heat Dissipating Plate and Grid Connectors	Eimac HR-8
Maximum Overall Dimensions:	
Length	12-⅝ inches
Diameter	5-⅛ inches
Net Weight	1.3 pounds
Shipping Weight	5.8 pounds

MAXIMUM RATINGS

Pulse Modulator Service (Per Tube)

D-C PLATE VOLTAGE	30 MAX. KILOVOLTS
D-C GRID VOLTAGE	-2.0 MAX. KILOVOLTS
PEAK POSITIVE PLATE VOLTAGE	35 MAX. KILOVOLTS
PEAK POSITIVE GRID VOLTAGE	1.6 MAX. KILOVOLTS
PEAK PLATE CURRENT	15 MAX. AMPERES
AVERAGE GRID DISSIPATION	50 MAX. WATTS
AVERAGE PLATE DISSIPATON	300 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	28 kilovolts
D-C Grid Voltage	-1.5 kilovolts
Pulse Plate Current	15 amperes
Pulse Grid Current*	3.0 amperes
Pulse Positive Grid Voltage	1000 volts
Pulse Grid Driving Power*	7.5 kilowatts
Load: Resistive	1650 ohms
Duty	.002
Pulse Voltage Output	25 kilovolts
Pulse Power Input	420 kilowatts
Pulse Plate Dissipation	45 kilowatts
Pulse Power Output	375 kilowatts

*Approximate values.

(Revised 12-15-65) Copyright 1954, 1965 by Varian Associates

APPLICATION

Mounting—The 6C21 must be mounted vertically, base down or up. The leads to the plate and grid terminals should be flexible, and the tube must be protected from vibration and shock.

Cooling—Forced-air cooling of the filament stem structure is required. Base cooling requires a minimum air flow of 2½ cubic feet per minute directed through the tube base toward the filament press. If the hole in the socket is at least 1 inch in diameter and the manifold is the same diameter, a static pressure of ¼ inch of water is required at the manifold to provide the 2½ cubic feet per minute. Heat Dissipating Connectors (Eimac HR-8 or equivalent) must be used at the plate and grid terminals and unobstructed circulation of air around the tube is required in sufficient quantity to prevent the temperatures of grid and plate seals from exceeding 225°C. Forced ventilation of compartments or equipment in which the tube is located is always beneficial, though not necessarily required.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y. For satisfactory results, Tempilaq must be sprayed on the surface to be measured in a thin coat, covering as small an area as will serve the purpose.

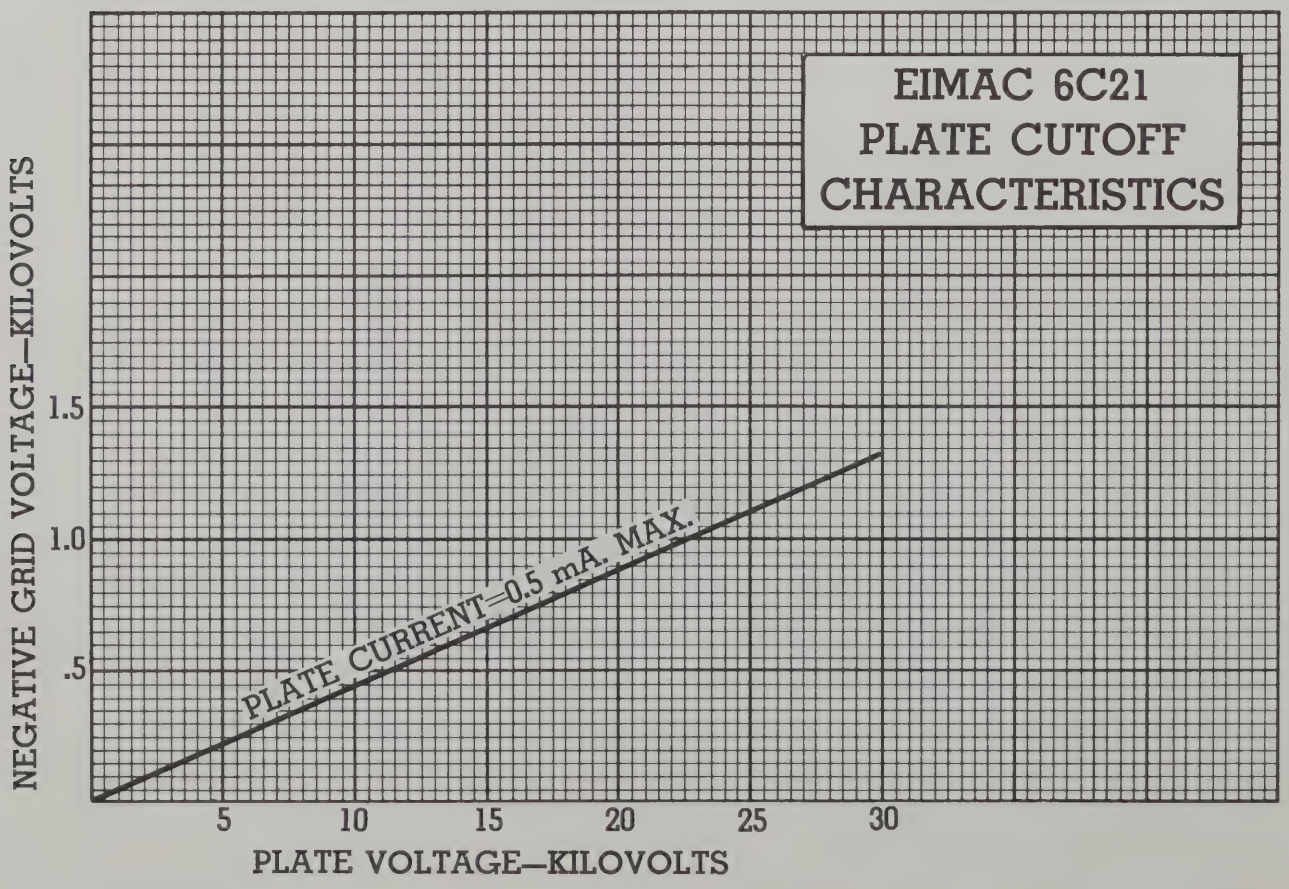
ELECTRICAL

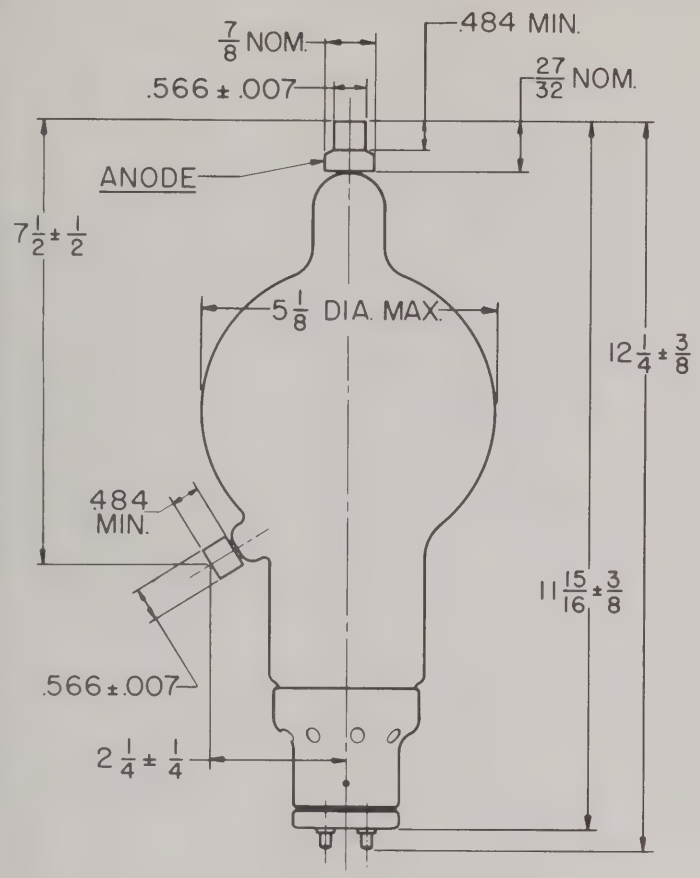
Filament Voltage—For optimum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 8.2 volts. Variations should be kept within the range of 7.9 to 8.5 volts. All four socket terminals should be used, with two placed in parallel for each filament connection.

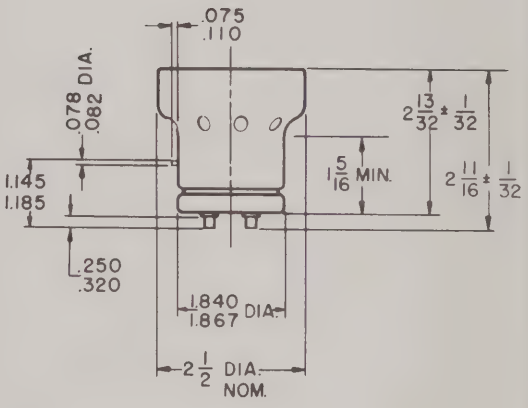
Plate Dissipation—Under normal operating conditions, the plate dissipation should not be allowed to exceed the maximum rating of 300 watts. Plate dissipation in excess of the maximum rating is permissable for short periods of time, such as during adjustment procedures.

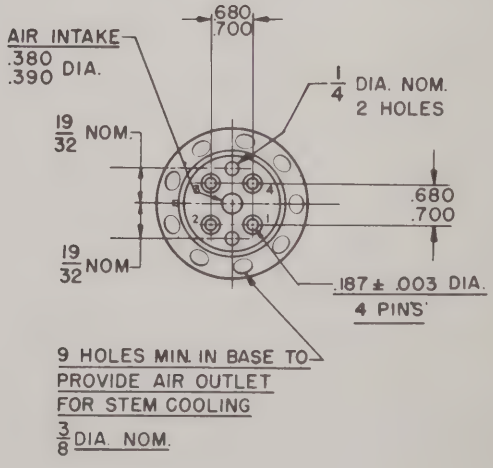
Operation—The 6C21 may be operated with inductive or resistive loads, provided only that the maximum ratings are not exceeded. The ratings listed for pulse modulator service are for operation at peak plate currents of 15 amperes and pulse lengths up to 100 milliseconds. Further information on pulse operation, such as tube limitations under long (100 milliseconds or more) pulse conditions, is contained in "Pulse Service Notes" obtainable from Eimac Division of Varian on request. If it is desired to operate the 6C21 under conditions widely different from those given for pulse modulator service, write Eimac Division of Varian for information and recommendations.

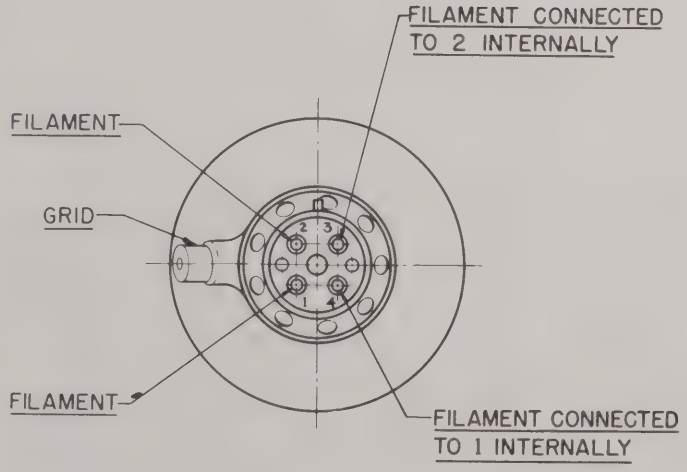
Useful information about pulse circuits may be obtained from such publications as "Pulse Generators," volume 5 of the MIT Radiation Laboratory Series, by McGraw-Hill, 1948.









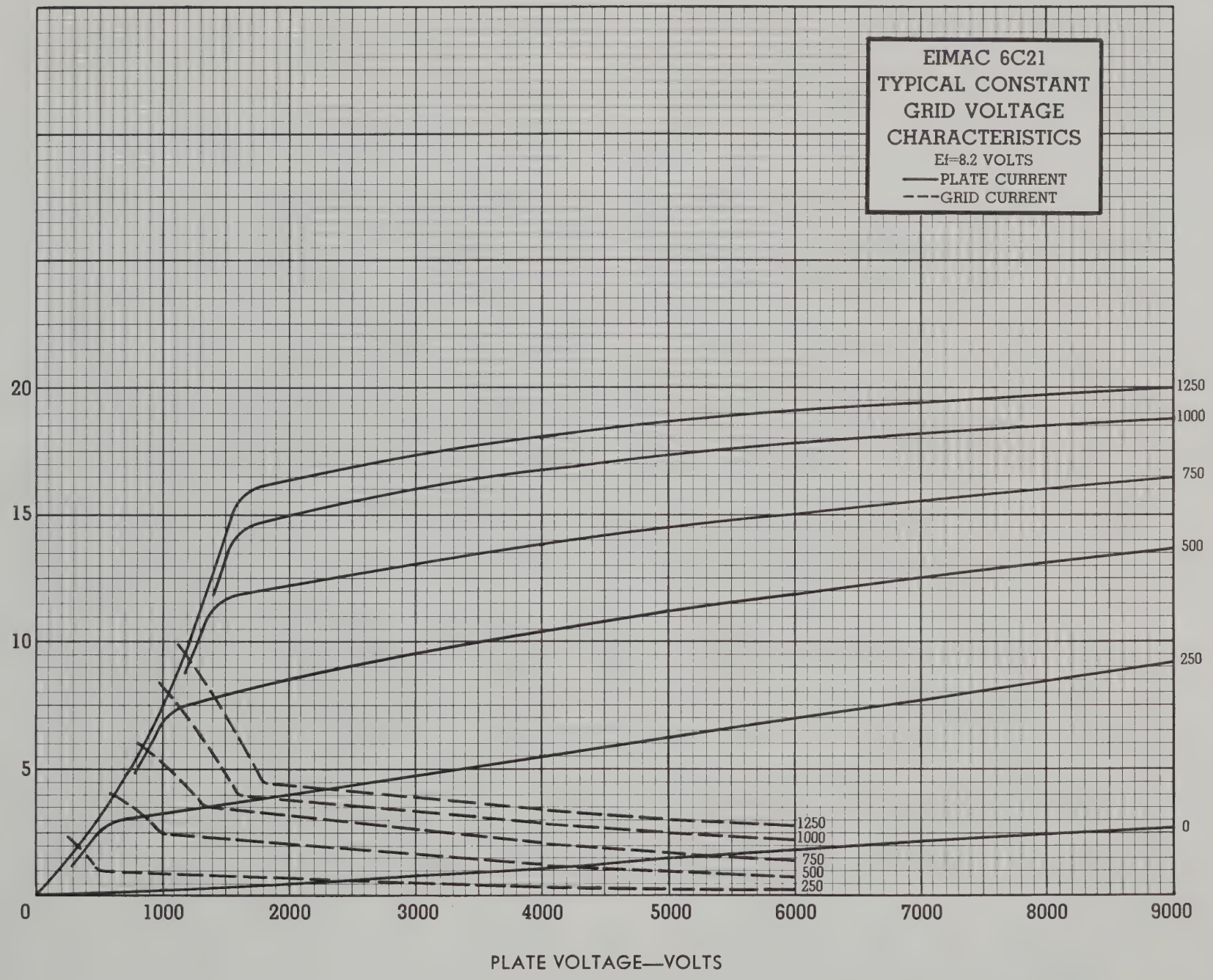


ON FINISHED TUBE ADD .060 MAX.
FOR SOLDER

BOTTOM VIEW

BASE DETAIL

DIMENSIONS
IN INCHES



Printed in U.S.A. 917

EIMAC
A Division of Varian Associates

8161
3CX2500A3
MEDIUM MU TRIODE

The Eimac 3CX2500A3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500A3 is an exact replacement for the Eimac 3X2500A3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube has a rugged, low-inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for V.H.F. operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals. The 3CX2500A3 may be installed or removed without the aid of tools.



ELECTRICAL — GENERAL CHARACTERISTICS

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	uuf
Grid-Filament	29.2		40.2	uuf
Plate-Filament	0.6		1.2	uuf
Transconductance (Ib = 830 ma., Eb = 3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			75	mc

MECHANICAL

Base	See drawing
Mounting	Vertical, base down or up
Cooling	Forced Air
Maximum Anode Core and Seal Temperatures	250°C
Maximum Over-all Dimensions:	
Length	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds
Shipping Weight (Average)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

(Conventional Neutralized Amplifier — Frequencies below 75Mc.)
Class-C FM or Telegraphy (Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. per tube)

D-C Plate Voltage	4000	5000	6000 volts
D-C Plate Current	2.5	2.5	2.08 amps
D-C Grid Voltage	—300	—450	—500 volts
D-C Grid Current*	245	265	180 ma
Peak R-F Grid Input Voltage*	580	750	765 volts
Driving Power*	142	197	136 watts
Grid Dissipation*	68	78	46 watts
Plate Power Input	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Power Output	7500	10,000	10,000 watts

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

(Conventional Neutralized Amplifier — Frequencies below 75Mc.)
Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	1670 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. per tube)

D-C Plate Voltage	4000	4500	5000 volts
D-C Plate Current	1.67	1.47	1.25 amps
D-C Grid Voltage	—450	—500	—550 volts
D-C Grid Current*	180	140	150 ma
Peak R F Grid Input Voltage*	685	715	760 volts
Driving Power*	125	100	115 watts
Grid Dissipation*	43	30	32 watts
Plate Power Input	6670	6615	6250 watts
Plate Dissipation	1670	1315	950 watts
Plate Power Output	5000	5300	5300 watts

*Approximate values.

(Revised 12-15-64) Copyright 1962, 1965 by Varian Associates

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	4000	5000	6000 volts
D-C Grid Voltage[1]	−150	−190	−240 volts
Zero-Signal D-C Plate Current	0.6	0.5	0.4 amps
Max-Signal D-C Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

Cooling —

Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 mc, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 mc).

Anode-to-Base Air Flow[1]

	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air-Flow

	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1]When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage —

The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

Bias Voltage —

There is little advantage in using bias voltages in excess of those given under "Typical Operation" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage —

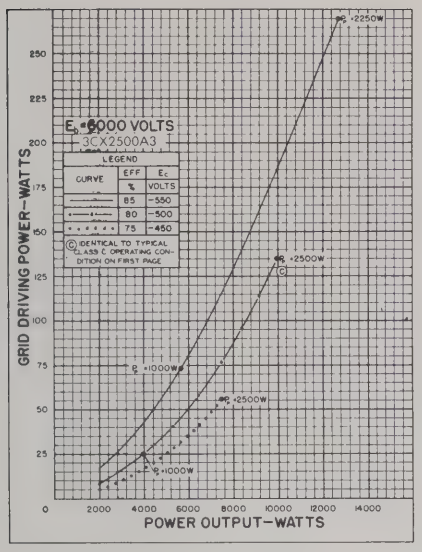
The plate-supply voltage for the 3CX2500A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

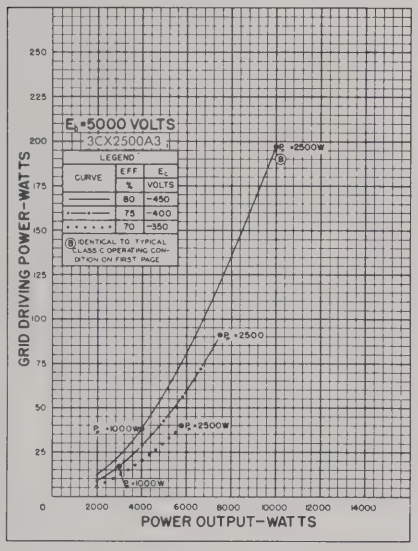
Grid Dissipation —

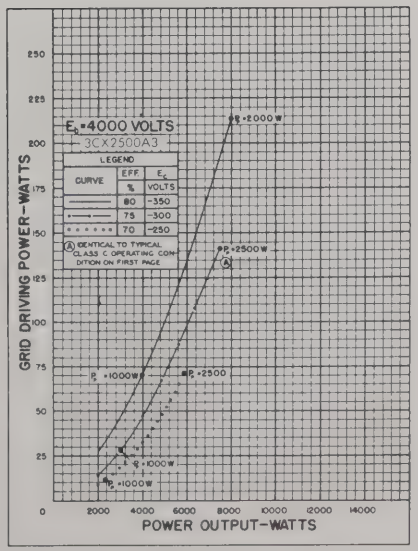
The power dissipated by the grid of the 3CX2500A3 must never exceed 150 watts. Grid dissipation is the product of d-c current and peak positive grid voltage.

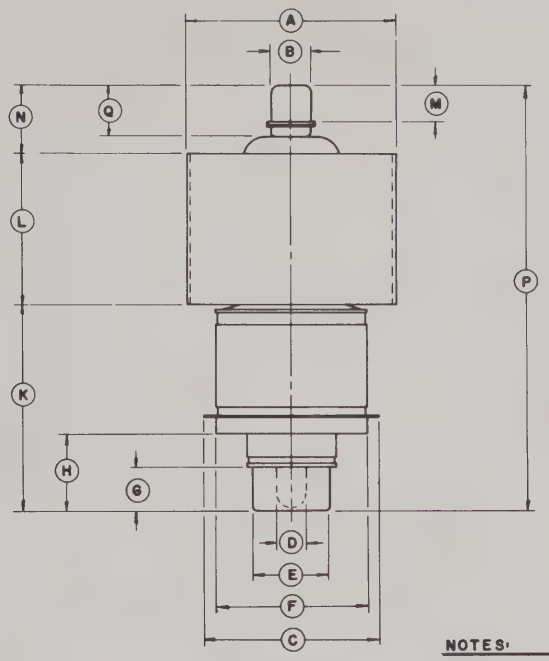
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

In VHF operation, particularly above 75 Mc., the d-c grid current must not exceed 200 ma. under any conditions of plate loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.

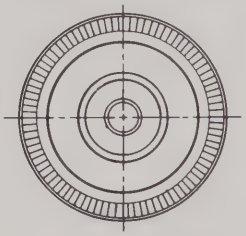








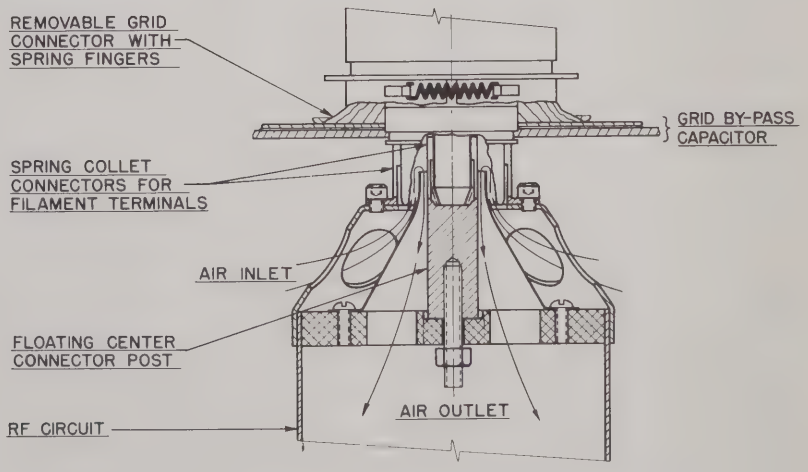
DIMENSIONAL DATA			
REF.	MIN.	MAX	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	.615	.635	
E	1.490	1.510	
F	2.990	3.010	
G	13/16	15/16	
H	1 3/8	1 5/8	
J	3/8	7/16	
K	3 7/8	4 1/4	
L	2 15/16	3 1/16	
M	11/16	13/16	
N	1 3/16	1 11/16	
P	8	9	
Q	1	1 1/8	



BOTTOM VIEW

NOTES:

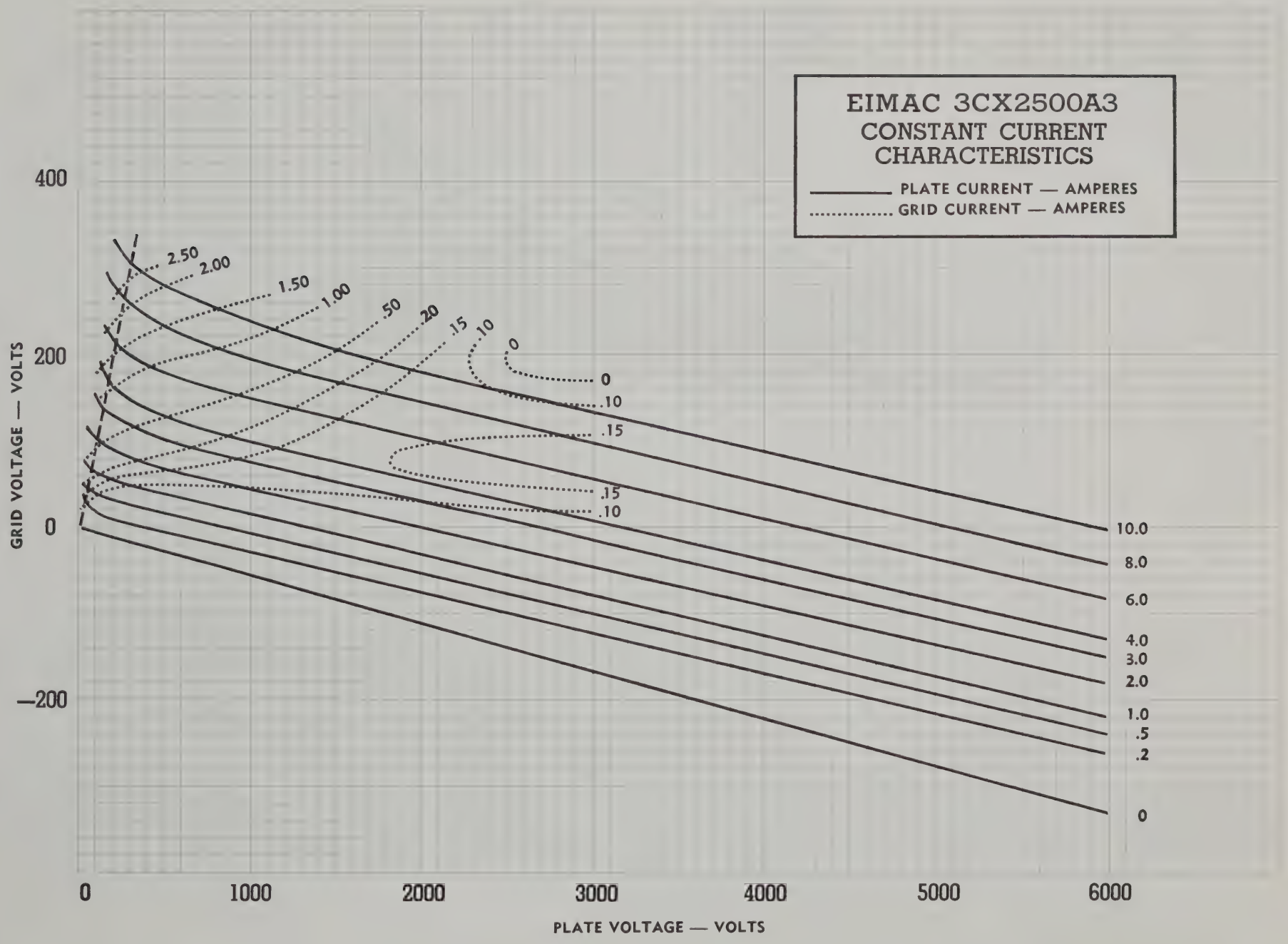
1. .040 MAXIUM RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAXIUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.
3. DIMENSIONS IN INCHES.



TYPICAL TUBE CONNECTORS AND STEM COOLING

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3CX2500A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

75TH

MEDIUM-MU TRIODE

•

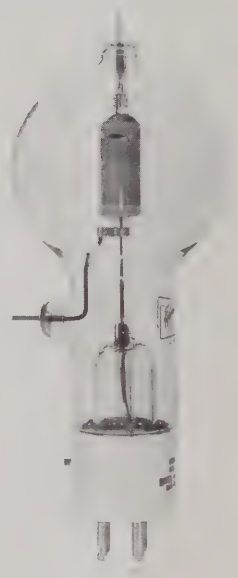
MODULATOR
OSCILLATOR
AMPLIFIER

EIMAC

A Division of Varian Associates
of CALIFORNIA

The Eimac 75TH is a medium-mu power triode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate dissipation rating of 75 watts and a maximum plate voltage rating of 3000 volts at frequencies up to 40 Mc. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 Mc.

The 75TH in Class-C R-F service will deliver up to 225 watts plate power output with 10 watts driving power. Two 75TH's in Class-B modulator service will deliver up to 300 watts maximum-signal plate power output with 3 watts driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.25 amperes
Amplification Factor (Average)	20
Direct Interelectrode Capacitances (Average)	
Grid-Plate	2.3 $\mu\mu$f
Grid-Filament	2.7 $\mu\mu$f
Plate-Filament	0.3 $\mu\mu$f
Transconductance (I_b=225 ma., E_b=3000 v.)	4150 μmhos
Highest Frequency for Maximum Ratings	40 Mc

MECHANICAL

Base	Medium 4-pin bayonet
Basing	See outline drawing
Socket	Johnson type No. 122-224, National type No. XC-4 or CIR-4, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat Dissipating Connectors:	
Plate	Eimac HR-3
Grid	Eimac HR-2
Maximum Overall Dimensions:	
Length	7.25 inches
Diameter	2.81 inches
Net Weight	3 ounces
Shipping Weight (Average)	1.5 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy (Key-down conditions, 1 tube)

MAXIMUM RATINGS (Frequencies up to 40 Mc.)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA.
PLATE DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	16 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 40 Mc.)

D-C Plate Voltage	1000	1500	2000	volts
D-C Grid Voltage	—80	—125	—200	volts
D-C Plate Current	215	167	150	ma.
D-C Grid Current (approx.)	35	23	32	ma.
Peak R-F Grid Input Voltage (approx.)	270	280	350	volts
Driving Power (approx.)	9	6	10	watts
Plate Power Input	215	250	300	watts
Plate Dissipation	75	75	75	watts
Plate Power Output	140	175	225	watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 40 Mc.)

D-C PLATE VOLTAGE	2400 MAX. VOLTS
D-C PLATE CURRENT	180 MAX. MA.
PLATE DISSIPATION	50 MAX. WATTS
GRID DISSIPATION	16 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 40 Mc.)

D-C Plate Voltage	1000	1500	2000	volts
D-C Grid Voltage	—150	—200	—300	volts
D-C Plate Current	135	115	110	ma.
D-C Grid Current (approx.)	20	14	15	ma.
Peak R-F Grid Input Voltage (approx.)	300	330	440	volts
Driving Power (approx.)	6	5	6	watts
Grid Dissipation	3	2	2	watts
Plate Power Input	135	175	220	watts
Plate Dissipation	50	50	50	watts
Plate Power Output	85	125	170	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-B

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	225 MAX. MA.
PLATE DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	16 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1000	1500	2000	volts
D-C Grid Voltage (approx.)[1]	—30	—60	—90	volts
Zero-Signal D-C Plate Current	90	67	50	ma.
Max-Signal D-C Plate Current	350	267	225	ma.
Effective Load, Plate-to-Plate	5300	11,400	19,300	ohms
Peak A-F Grid Input Voltage (per tube)	175	165	175	volts
Max-Signal Driving Power (approx.)	7	4	3	watts
Max-Signal Plate Dissipation (per tube)	75	75	75	watts
Max-Signal Plate Power Output	200	250	300	watts
Total Harmonic Distortion	1.5	2.0	2.0	per cent

[1]Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING MAXIMUM RATINGS, WRITE EIMAC, A DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 75TH must be mounted vertically, base down or up. The plate and grid leads should be flexible. The tube must be protected from vibration and shock.
Cooling—Heat Dissipating Connectors (Eimac HR-3 and HR-2) should be used at the plate and grid terminals of the 75TH. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling for the plate and grid seals.

Cooling requirements will be met if the temperature of the plate and grid seals is not allowed to exceed 225°C. One method of measuring these temperatures is provided by the use of "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, New York 11, N.Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range of 4.75 to 5.25 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 75TH, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate-supply voltage for the 75TH should not exceed 3000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—The power dissipated by the grid of the 75TH must not exceed 16 watts. Grid dissipation may be calculated from the following expression:

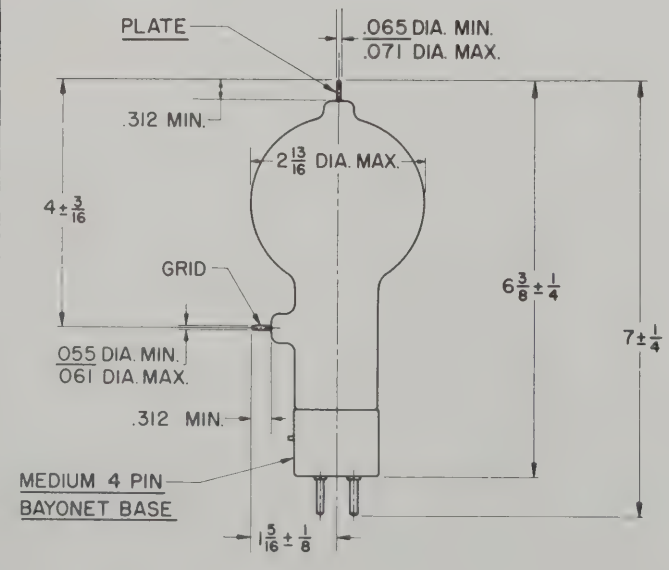
$$P_g = e_{cmp} I_c$$

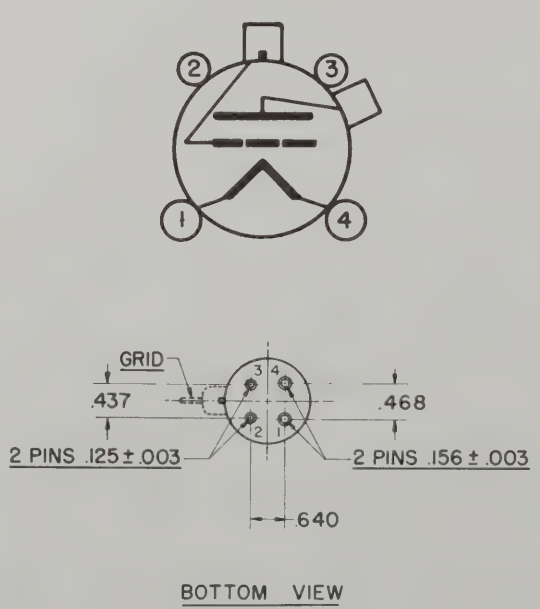
where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid[1]. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—The plate of the 75TH operates at a visibly red temperature at its maximum rated dissipation of 75 watts. Plate dissipation in excess of the maximum rating is permissible only for short periods of time, such as during tuning procedures.

[1] For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings", **Eimac News**, January, 1945. This article is available in reprint form on request.

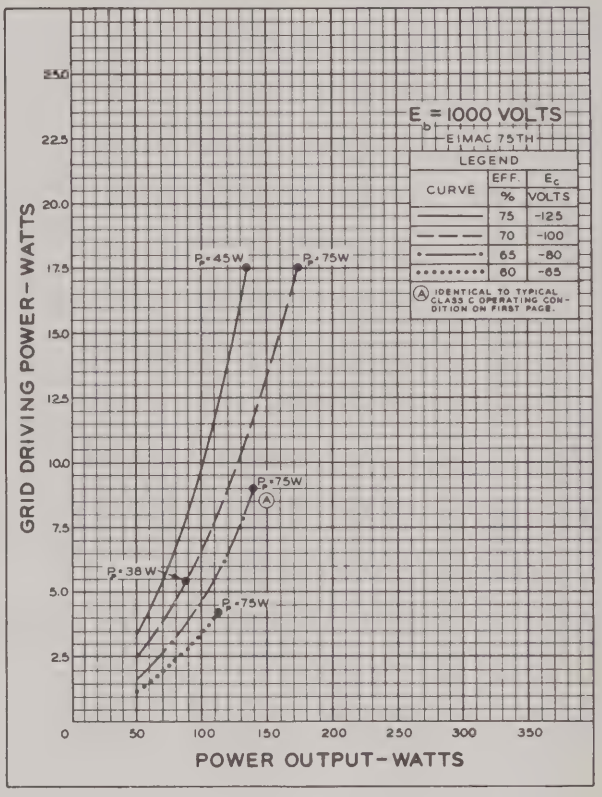


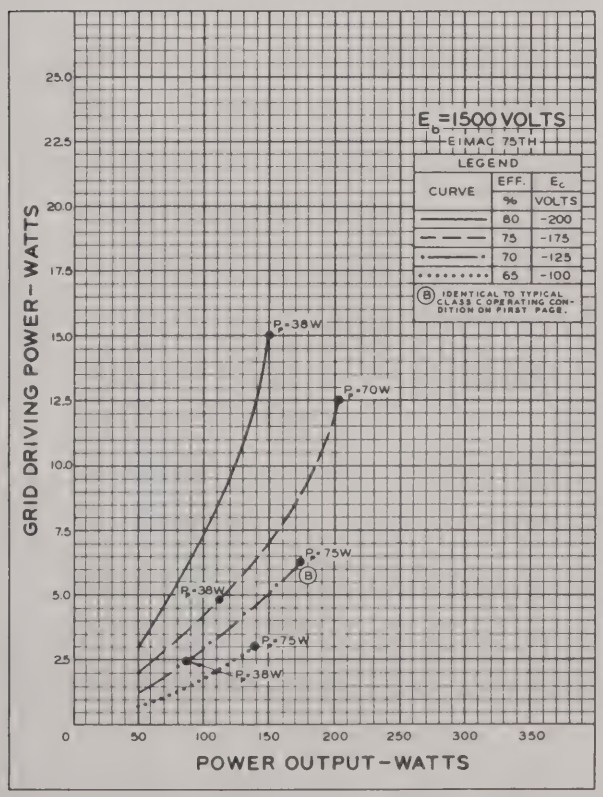


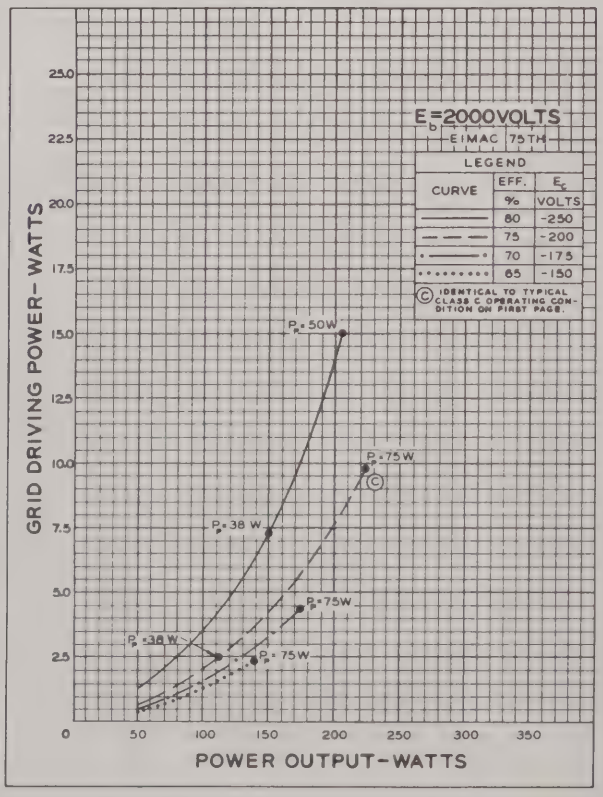
DRIVING POWER vs. POWER OUTPUT

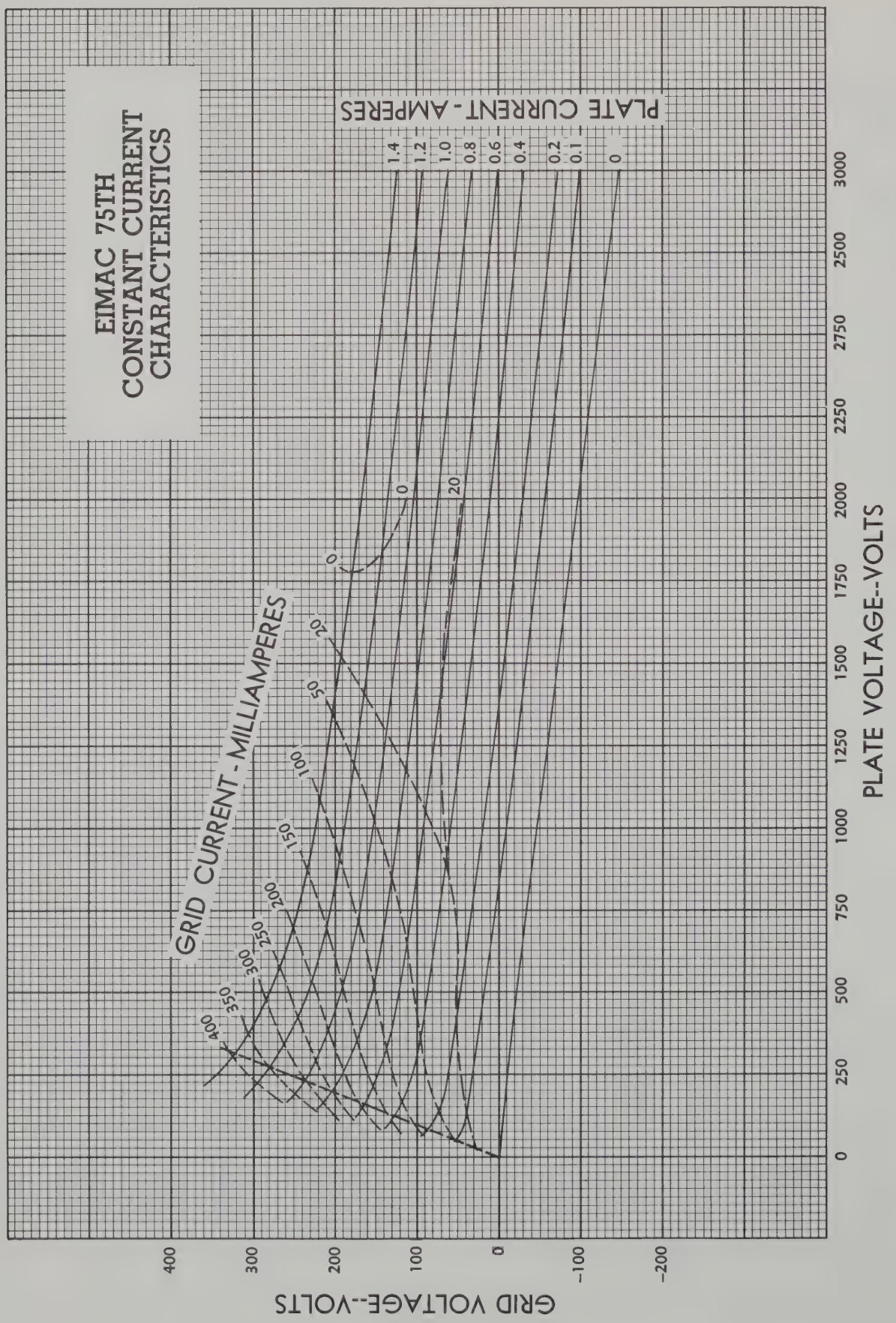
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.









Printed in U.S.A. 34782

(Effective 12-15-65) Copyright 1952, 1965 by Varian Associates

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

450TH

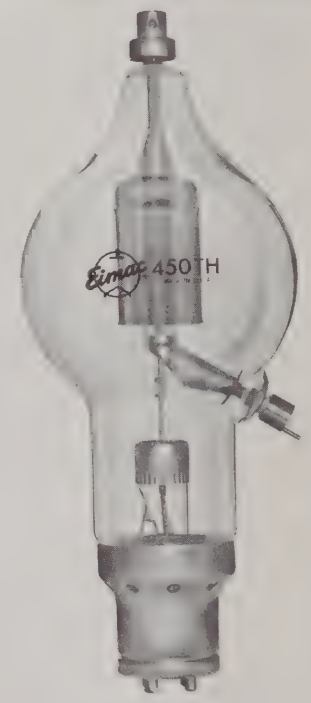
HIGH-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 450TH is a high-mu power triode having a maximum plate dissipation rating of 450 watts, and is intended for use as an amplifer, oscillator and modulator. It can be used at its maximum ratings at frequencies as high as 40 Mc.

Cooling of the 450TH is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipaton, and by means of air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	7.5 volts
Current	12.0 amperes

Note: Dual connections for each filament lead are provided within the base of the tube (see basing diagram). Corresponding socket terminals must be connected in parallel to provide proper distribution of filament and R-F charging currents.

Amplification Factor (Average)	38
Direct Interelectrode Capacitances (Average)	
Grid-plate	5.0 $\mu\mu$fd.
Grid-Filament	8.8 $\mu\mu$fd.
Plate-Filament	0.8 $\mu\mu$fd.
Transconductance (i_b=500 ma., E_b=4000 v.)	6650 μmhos
Frequency for maximum ratings	40 Mc.

MECHANICAL

Base	Special 4 pin, No. 5002B
Basing	RMA type 4AQ
Mounting	Vertical, base down or up
Cooling	Radiation and air circulation

Note: Adequate ventilation or air cooling must be provided so that the seals and envelope do not exceed 200°C under operating conditions.

Socket - - - - Johnson Type No. 211 or National Type No. XM50 or equivalent.

Recommended Heat Dissipating Connectors:

Plate	Eimac HR-8
Grid	Eimac HR-8

Note: The grid terminal of the 450TH is now .560" in diameter. To accommodate existing equipment designed for the older style 450TH having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal, if used, requires an HR-4 heat dissipating connector. (See outline drawing.)

Maximum Overall Dimensions:

Length	12.625 inches
Diameter	5.125 inches
Net weight	1.3 pounds
Shipping weight (Average)	5.6 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT PER TUBE	600 MAX. MA.
PLATE DISSIPATION, PER TUBE	450 MAX. WATTS

TYPICAL OPERATION—2 TUBES

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage (approx.)*	—50	—85	—115	Volts
Zero-Signal D-C Plate Current	200	150	120	Ma.
Max-Signal D-C Plate Current	770	675	620	Ma.
Effective Load, Plate-to-Plate	7800	12,800	18,600	Ohms
Peak A-F Grid Input Voltage (per tube)	225	235	267	Volts
Max-Signal Peak Driving Power	40	34	40	Watts
Max-Signal Nominal Driving Power (approx.)	20	17	20	Watts
Max-Signal Plate Power Output	1400	1800	2200	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4500 MAX. VOLTS
D-C PLATE CURRENT	500 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	4500	Volts
D-C Plate Current	380	340	345	Ma.
Total Bias Voltage	—250	—300	—350	Volts
Fixed Bias Voltage	—100	—150	—175	Volts
Grid Resistor	2500	3500	3500	Ohms
D-C Grid Current	60	43	50	Ma.
Peak R-F Grid Input Voltage	490	525	585	Volts
Driving Power (approx.)	30	23	29	Watts
Grid Dissipation	14	10	12	Watts
Plate Power Input	1150	1360	1550	Watts
Plate Dissipation	300	300	300	Watts
Plate Power Output	850	1060	1250	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class-C amplifier. The output figures do not allow for circuit losses.

(Revised 12-15-65) Copyright 1950, 1965 by Varian Associates

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube).

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA.
PLATE DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage	—175	—200	—300	Volts
D-C Plate Current	500	450	450	Ma.
D-C Grid Current	95	85	90	Ma.
Peak R-F Grid Input Voltage	400	410	570	Volts
Driving Power (approx.)	35	35	46	Watts
Grid Dissipation	21	18	24	Watts
Plate Power Input	1500	1800	2250	Watts
Plate Dissipation	450	450	450	Watts
Plate Power Output	1050	1350	1800	Watts

*The figures show actual measured tube performance and do not allow for circuit losses.

APPLICATION

MECHANICAL

Mounting—The 450TH must be mounted vertically, base up or base down. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 450TH. In the event that the design of the equipment restricts natural circulation, the use of a small fan or centrifugal blower to provide additional cooling for the tube will aid in obtaining maximum tube life. Special heat-dissipating connectors (Eimac HR-8) are available for use on the plate and grid terminals. These connectors help to prolong tube life by reducing the temperature of the seals.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Unavoidable variations in fialment voltage must be kept within the range from 7.03 to 7.88 volts. All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 450TH, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 450TH must not exceed 80 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cpm} I_c$$

where P_g = Grid dissipation,

e_{cmp} = Peak positive grid voltage, and

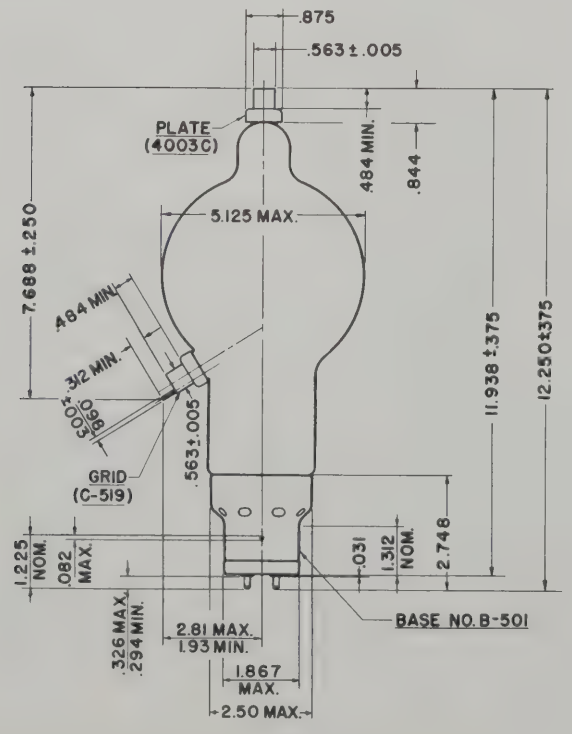
I_c = D-c grid current.

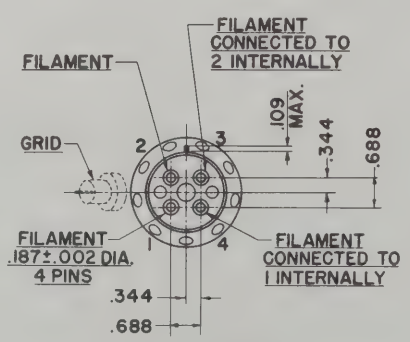
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.[1] In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any conditions of loading.

Plate Voltage—Except in very special applications, the plate supply voltage for the 450TH should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

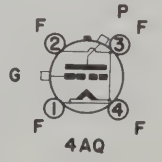
Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 450TH should not be allowed to exceed 450 watts. At this dissipation the brightness temperature of the plate will appear a visible red color. The value of this color is somewhat effected by light from the filament as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

[1]For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News**, January, 1945. This article is available in reprint form on request.





BOTTOM VIEW

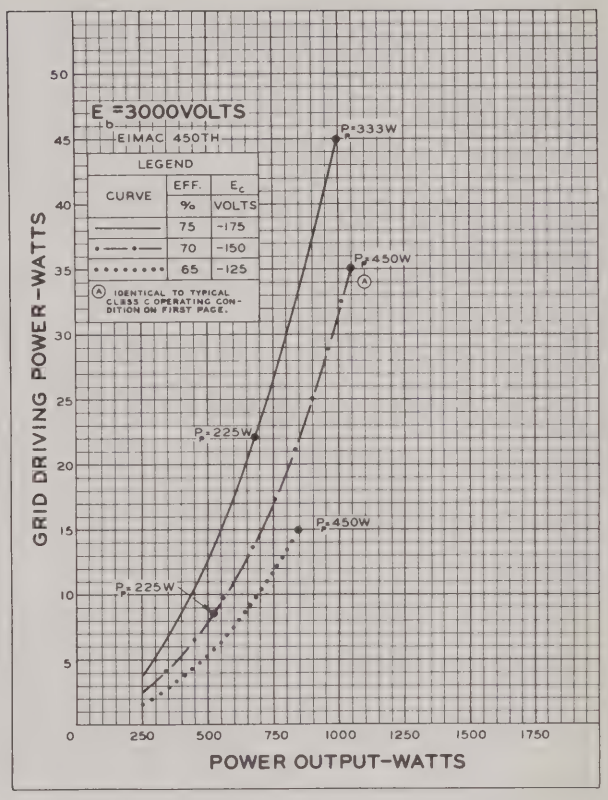


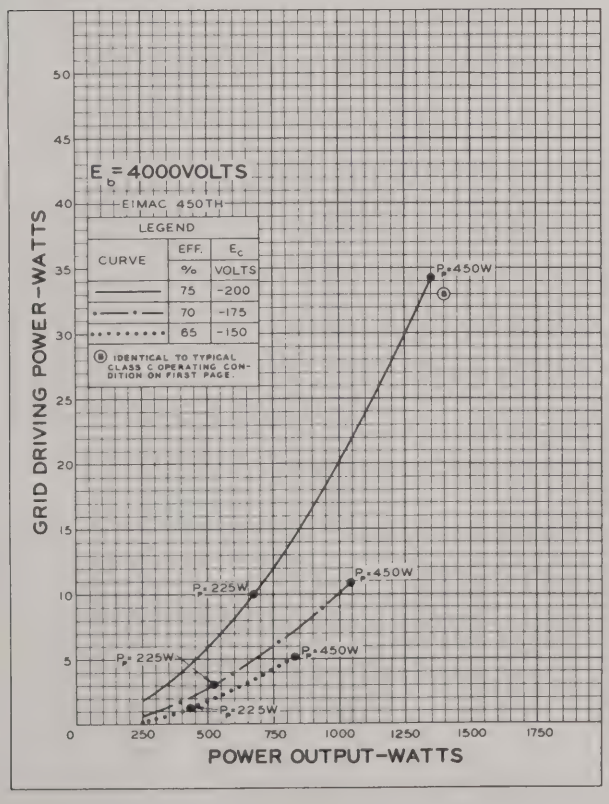
NOTE:—The grid terminal on the new 450TH and TL type tube is now .563" in diameter. To accommodate existing equipment which uses the 450TH or TL tubes with the old style .098" grid terminal, an adapter pin is provided. This adapter pin, if not needed, may be removed by unscrewing.

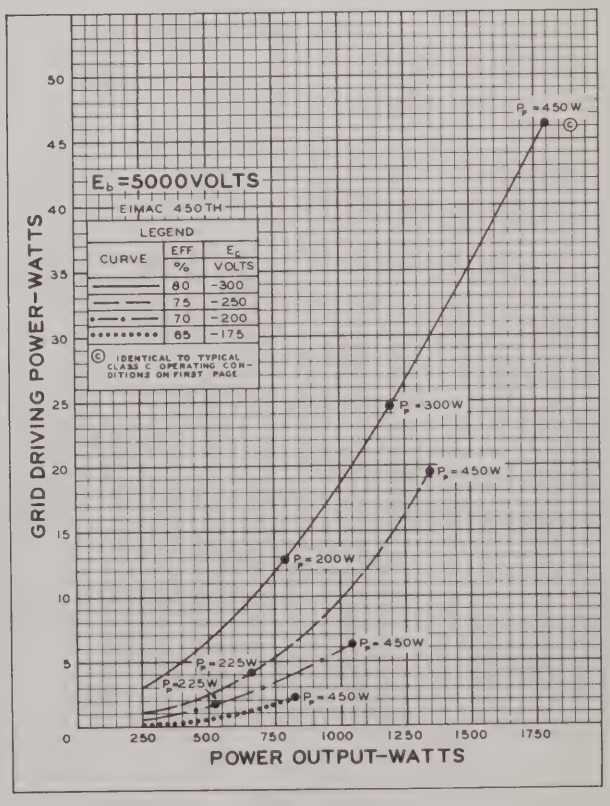
DRIVING POWER vs. POWER OUTPUT

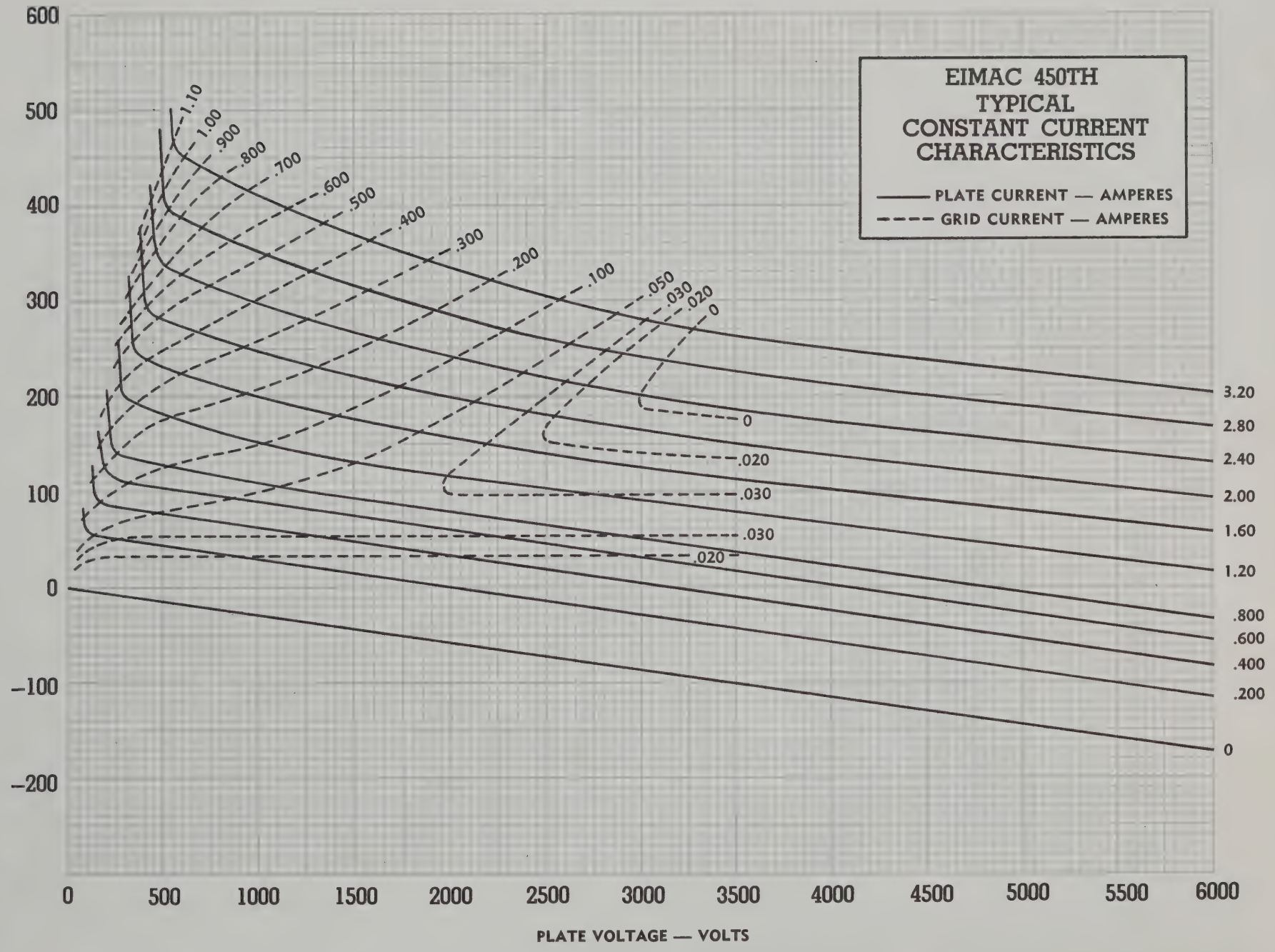
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.









Printed in U.S.A.

Eimac®

EIMAC

A Division of Varian Associates

450TL

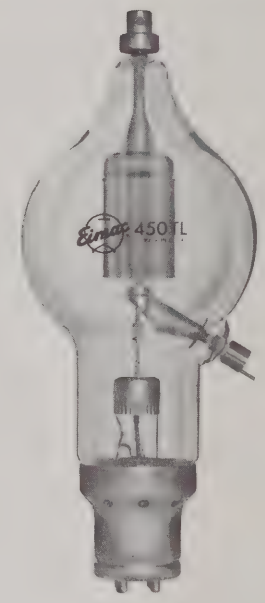
MEDIUM-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 450TL is a medium-mu power triode having a maximum plate dissipation rating of 450 watts, and is intended for use as an amplifier, oscillator and modulator. It can be used at its maximum ratings at frequencies as high as 40-Mc.

Cooling of the 450TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	7.5 volts
Current	12.0 amperes

Note: Dual connections for each filament lead are provided within the base of the tube (see basing diagram). Corresponding socket terminals must be connected in parallel to provide proper distribution of filament and R-F charging currents.

Amplification Factor (Average)	18
Direct Interelectrode Capacitances (Average)	
Grid-Plate	4.5 $\mu\mu$f
Grid-Filament	6.8 $\mu\mu$f
Plate-Filament	0.8 $\mu\mu$f
Transconductance (i_b=500ma, E_b=4000v, e_c= —75v.)	5000 μmhos
Frequency for Maximum Ratings	40-Mc.

MECHANICAL

Base	Special 4 pin, No. 5002B
Basing	RMA type 4AQ
Mounting	Vertical, base down or up
Cooling	Radiation and air circulation

Note: Adequate ventilation or air cooling must be provided so that the seals and envelope do not exceed 200°C under operating conditions.

Socket — Johnson Type No. 211 or National Type No. XM50 or equivalent.

Recommended Heat Dissipating Connectors:

Plate	Eimac HR-8
Grid	Eimac HR-8

Note: The grid terminal of the 450TL is now .560" in diameter. To accommodate existing equipment designed for the older style 450TL having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal, if used, requires an HR-4 heat dissipating connector. (See outline drawing.)

Maximum Overall Dimensions:	
Length	12.625 inches
Diameter	5.125 inches
Net weight	1.3 pounds
Shipping weight (Average)	5.6 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT PER TUBE	600 MAX. MA.
PLATE DISSIPATION, PER TUBE	450 MAX. WATTS

TYPICAL OPERATION—2 TUBES

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage (approx.)*	—110	—175	—240	Volts
Zero-Signal D-C Plate Current	200	150	120	Ma.
Max-Signal D-C Plate Current	770	675	620	Ma.
Effective Load, Plate-to-Plate	7700	12,800	18,500	Ohms
Peak A-F Grid Input Voltage (per tube)	325	365	430	Volts
Max-Signal Peak Driving Power	40	33	56	Watts
Max-Signal Nominal Driving Power (approx.)	20	17	28	Watts
Max-Signal Plate Power Output	1400	1800	2200	Watts

*Adjust to give stated zero-signal plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube).

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA.
PLATE DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	65 MAX. WATTS

TYPICAL OPERATON, PER TUBE*

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage	—275	—400	—500	Volts
D-C Plate Current	500	450	450	Ma.
D-C Grid Current	65	53	54	Ma.
Peak R-F Grid Input Voltage	640	740	870	Volts
Driving Power (approx.)	38	35	42	Watts
Grid Dissipation	20	13	15	Watts
Plate Power Input	1500	1800	2250	Watts
Plate Dissipation	450	450	450	Watts
Plate Power Output	1050	1350	1800	Watts

*The figures show actual measured tube performance and do not allow for circuit losses.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4500 MAX. VOLTS
D-C PLATE CURRENT	500 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	65 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	4500	Volts
D-C Plate Current	380	340	345	Ma.
Total Bias Voltage	—400	—500	—550	Volts
Fixed Bias Voltage	—200	—250	—275	Volts
Grid Resistor	5000	7000	7500	Ohms
D-C Grid Current	40	36	36	Ma.
Peak R-F Grid Input Voltage	700	790	850	Volts
Driving Power	28	29	31	Watts
Grid Dissipation	12	11	11	Watts
Plate Power Input	1150	1360	1550	Watts
Plate Dissipation	300	300	300	Watts
Plate Power Output	850	1060	1250	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class-C amplifier. The output figures do not allow for circuit losses.

(Revised 12-15-65) Copyright 1949, 1965 by Varian Associates

APPLICATION

MECHANICAL

Mounting—The 450TL must be mounted vertically, base up or base down. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 450TL. In the event that the design of the equipment restricts natural circulation, the use of a small fan or centrifugal blower to provide additional cooling for the tube will aid in obtaining maximum tube life. Special heat-dissipating connectors (Eimac HR-8) are available for use on the plate and grid terminals. These connectors help to prolong tube life by reducing the temperature of the seals.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Unavoidable variations in filament voltage must be kept within the range from 7.03 to 7.88 volts. All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 450TL, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 450TL must not exceed 65 watts. Grid dissipation may be calculated from the following expression:

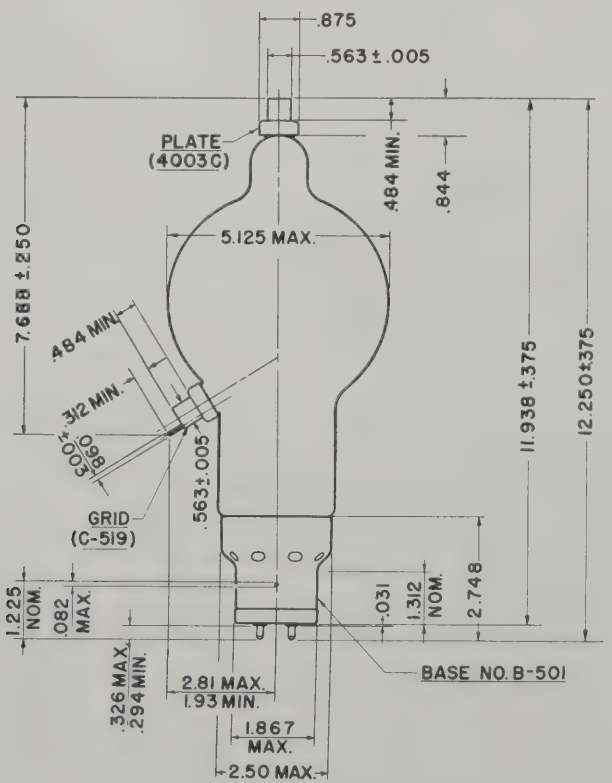
$$P_g = e_{cmp} I_c$$

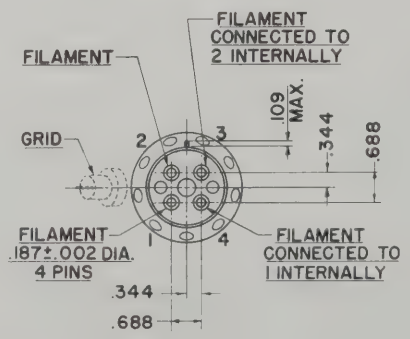
where P_g = Grid dissipation
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

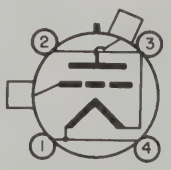
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any conditions of loading.

Plate Voltage—Except in very special applications, the plate supply voltage for the 450TL should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 450TL should not be allowed to exceed 450 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.





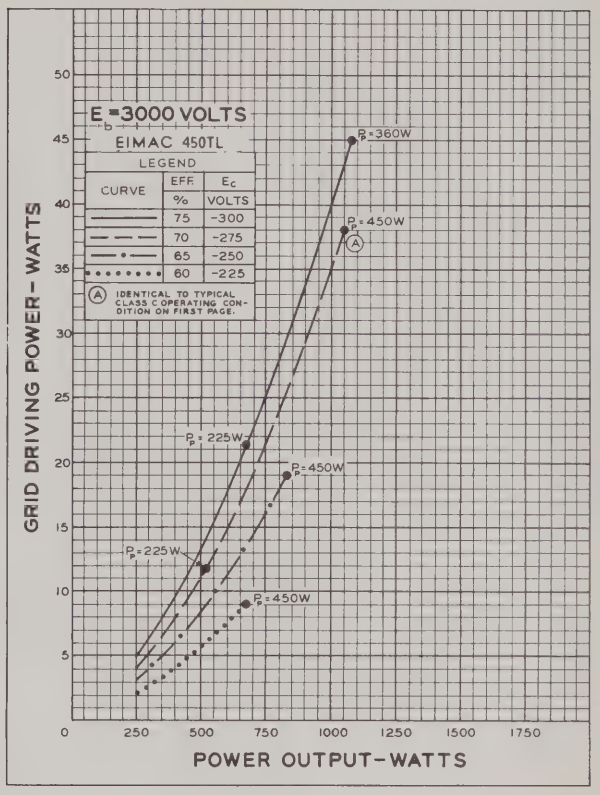


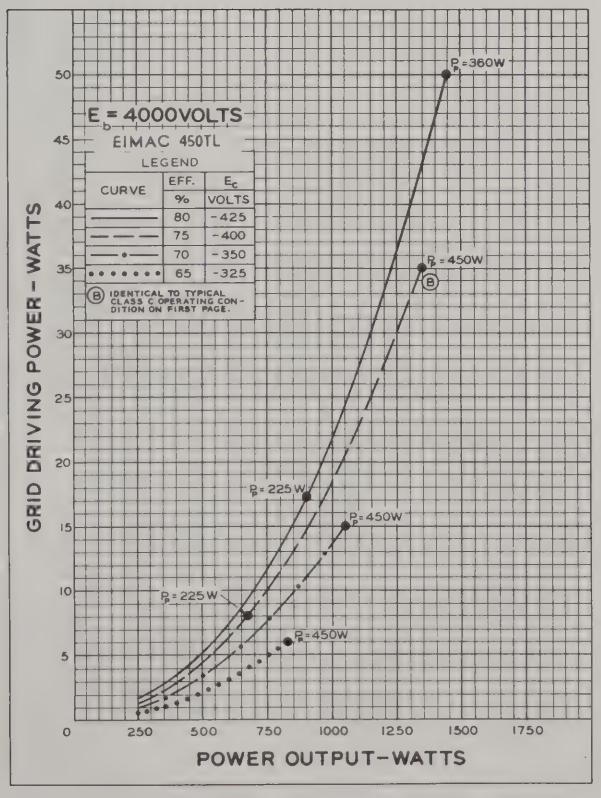
NOTE:—The grid terminal on the new 450TH and TL type tube is now .563" in diameter. To accommodate existing equipment which uses the 450TH or TL tubes with the old style .098" grid terminal, an adaptor pin is provided. This adaptor pin, if not needed, may be removed by unscrewing.

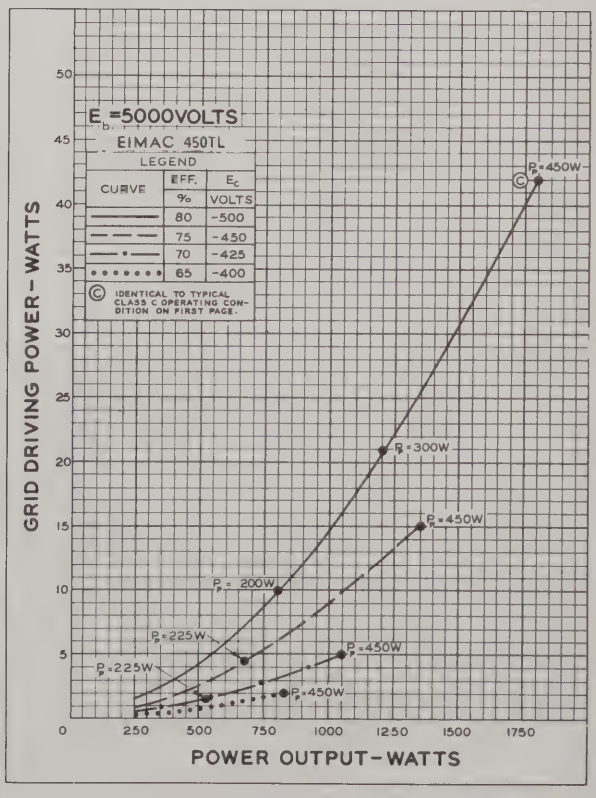
DRIVING POWER vs. POWER OUTPUT

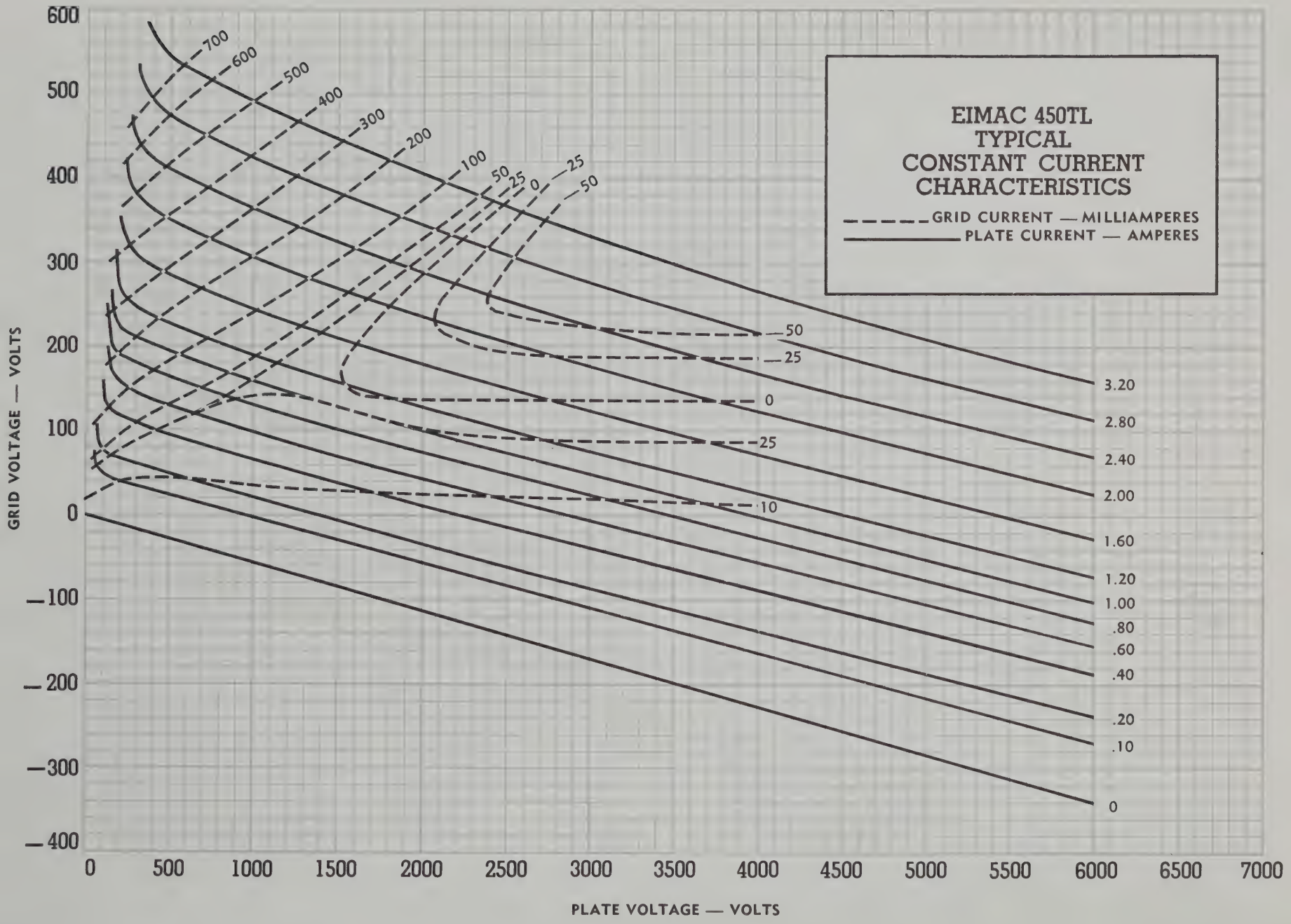
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.








EIMAC 450TL
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — MILLIAMPERES
PLATE CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
600
500
400
300
200
100
0
—100
—200
—300
—400
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
700
600
500
400
300
200
100
50
25
0
—25
—50
50
25
0
25
10
3.20
2.80
2.40
2.00
1.60
1.20
1.00
.80
.60
.40
.20
.10
0

EIMAC

A Division of Varian Associates

1000T

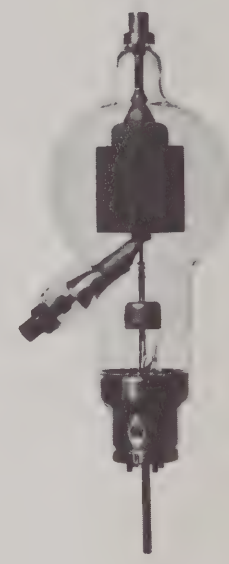
HIGH-MU TRIODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 1000T is a high-mu power triode intended for use as a modulator, oscillator, or amplifier. The tube has a maximum plate dissipation rating of 1000 watts, and a maximum plate voltage rating of 7500 volts at frequencies up to 50 Mc. Cooling is by forced air and radiation.

The 1000T in Class-C r-f service will deliver up to 3000 watts plate power output with 60 watts driving power. Two 1000T's in Class AB_2 modulator service will deliver up to 4600 watts maximum signal plate power output with 60 watts driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 volts ± 5%
Current	15.5 amperes
Amplification Factor (Average)	35
Direct Interelectrode Capacitances (Average)	
Grid-Plate	5.1 μμf
Grid-Filament	9.3 μμf
Plate-Filament	0.5 μμf
Transconductance (I_b=750ma., E_b=6000v.)	9050 μmhos
Highest Frequency for Maximum Ratings	50 Mc

MECHANICAL

Base	50-watt jumbo 4-pin with air-conduction pipe
Connections	See outline drawing
Socket	Johnson type No. 123-211 or equivalent
Mounting Position	Vertical, base down or up
Cooling	Forced air and radiation
Maximum Temperature of Grid and Plate Seals	225°C
Recommended Grid and Plate Heat Dissipating Connectors	Eimac HR-9
Maximum Dimensions:	
Seated Height	12.3 inches
Diameter	5.13 inches
Net Weight	1.25 pounds
Shipping Weight (Average)	6.25 pounds

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_2

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C PLATE CURRENT	750 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Grid Voltage[1]	−85	−125	−160	volts
Zero-Signal D-C Plate Current	335	270	220	ma
Max-Signal D-C Plate Current	1.25	1.14	1.05	amps
Effective Load, Plate-to-Plate	6250	9200	13,300	ohms
Peak A-F Grid Voltage (per tube)	260	290	335	volts
Max-Signal Driving Power*	35	37	60	watts
Max-Signal Plate Power Input	5000	5700	6300	watts
Max-Signal Plate Power Output	3000	3700	4600	watts

[1]Adjust to stated Zero-Signal Plate Current.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 50 Mc.)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C PLATE CURRENT	750 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 50 Mc.)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Grid Voltage	−150	−150	−225	−350	volts
D-C Plate Current	750	713	667	667	ma
D-C Grid Current*	90	100	87	110	ma
Peak R-F Grid Voltage	350	365	420	610	volts
Driving Power*	30	33	33	60	watts
Grid Dissipation*	21	19	14	25	watts
Plate Power Input	2250	2850	3335	4000	watts
Plate Power Output	1350	1850	2335	3000	watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 50 Mc.)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA
PLATE DISSIPATION	665 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 50 Mc.)

D-C Plate Voltage	4000	5000	6000	volts
D-C Grid Voltage	−300	−400	−500	volts
D-C Plate Current	600	600	600	ma
D-C Grid Current*	80	90	95	ma
Peak R-F Grid Voltage	540	660	775	volts
Driving Power*	45	60	75	watts
Grid Dissipation*	20	24	25	watts
Plate Power Input	2400	3000	3600	watts
Plate Power Output	1735	2335	2935	watts

*Approximate values

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

(Revised 12-15-65) Copyright 1952, 1965 by Varian Associates

APPLICATION

MECHANICAL

Mounting—The 1000T must be mounted vertically. The base may be either down or up. The leads to the plate and grid terminals should be flexible, and the tube must be protected from vibration and shock.

Cooling—The envelope and seals of the 1000T require forced-air cooling. Air-conduction pipes are provided in the base of the tube and in the HR-9 plate and grid Heat-Dissipating Connectors. Two cubic feet of air per minute supplied to each of these pipes will satisfy the cooling requirements of the seals. An 8- or 10-inch fan located approximately a foot from the tube will provide sufficient cooling air for the envelope. Air must be supplied to the tube when plate and grid voltages are applied, and must be continued until these voltages are removed. In some cases, particularly in locations where the ambient temperature is high, or where the free circulation of air is impeded, cooling air must be supplied when filament voltage is applied, and continued for two or more minutes after all voltages are removed.

The temperature of the grid and plate seals must not be allowed to exceed 225°C. A convenient accessory for the measurements of these temperatures is "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

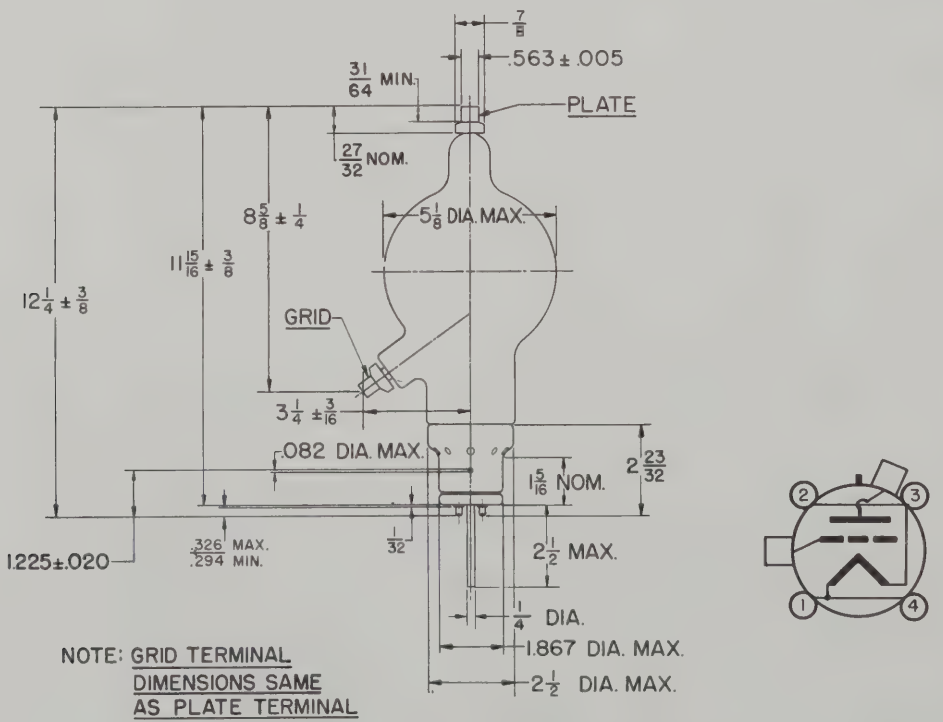
Filament—All four socket terminals should be used, putting two in parallel for each filament connection.

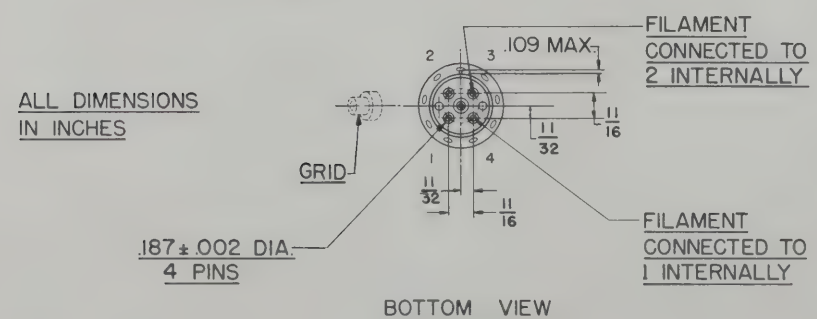
Bias Voltage—The maximum limit on bias voltages which may be used with the 1000T is considerably above those listed in "Typical Operation." Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The rated maximum d-c plate voltage of 7500 volts applies at frequencies up to 50 Mc. Above that frequency the tube must be operated at lower d-c voltages. In most cases there is little advantage in using plate supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—Grid dissipation may be assumed to be the product of the d-c grid current and the peak positive cathode-to-grid voltage. This assumption is sufficiently accurate for the purpose of determining that the 1000T is operating within its maximum rated grid dissipation of 80 watts.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 1000T should not be allowed to exceed 1000 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

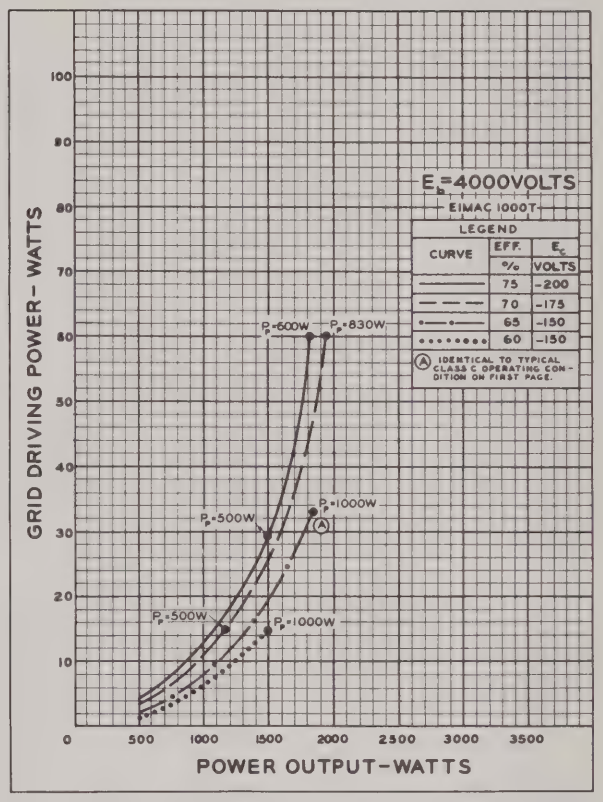


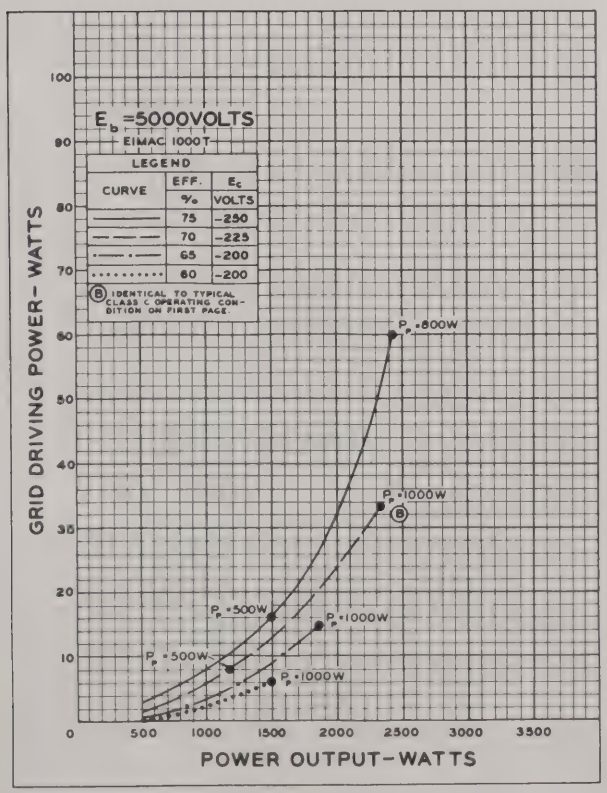


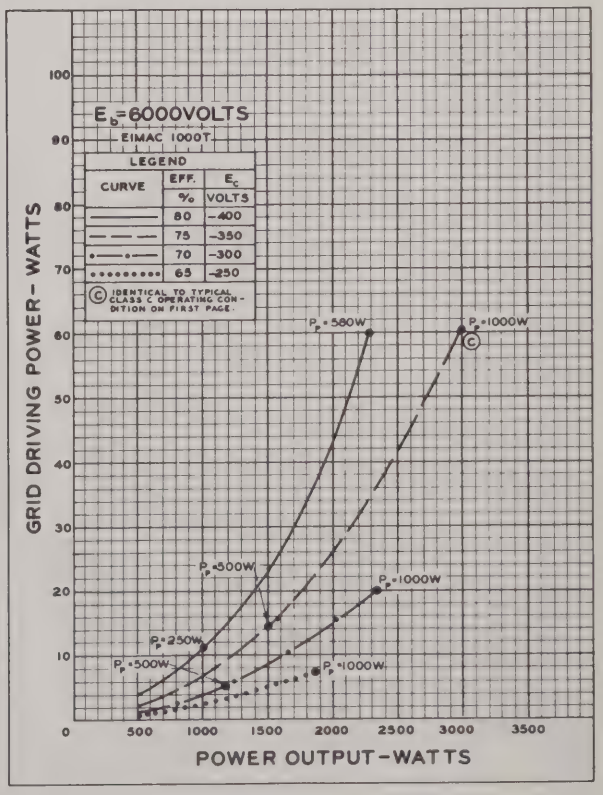
DRIVING POWER vs. POWER OUTPUT

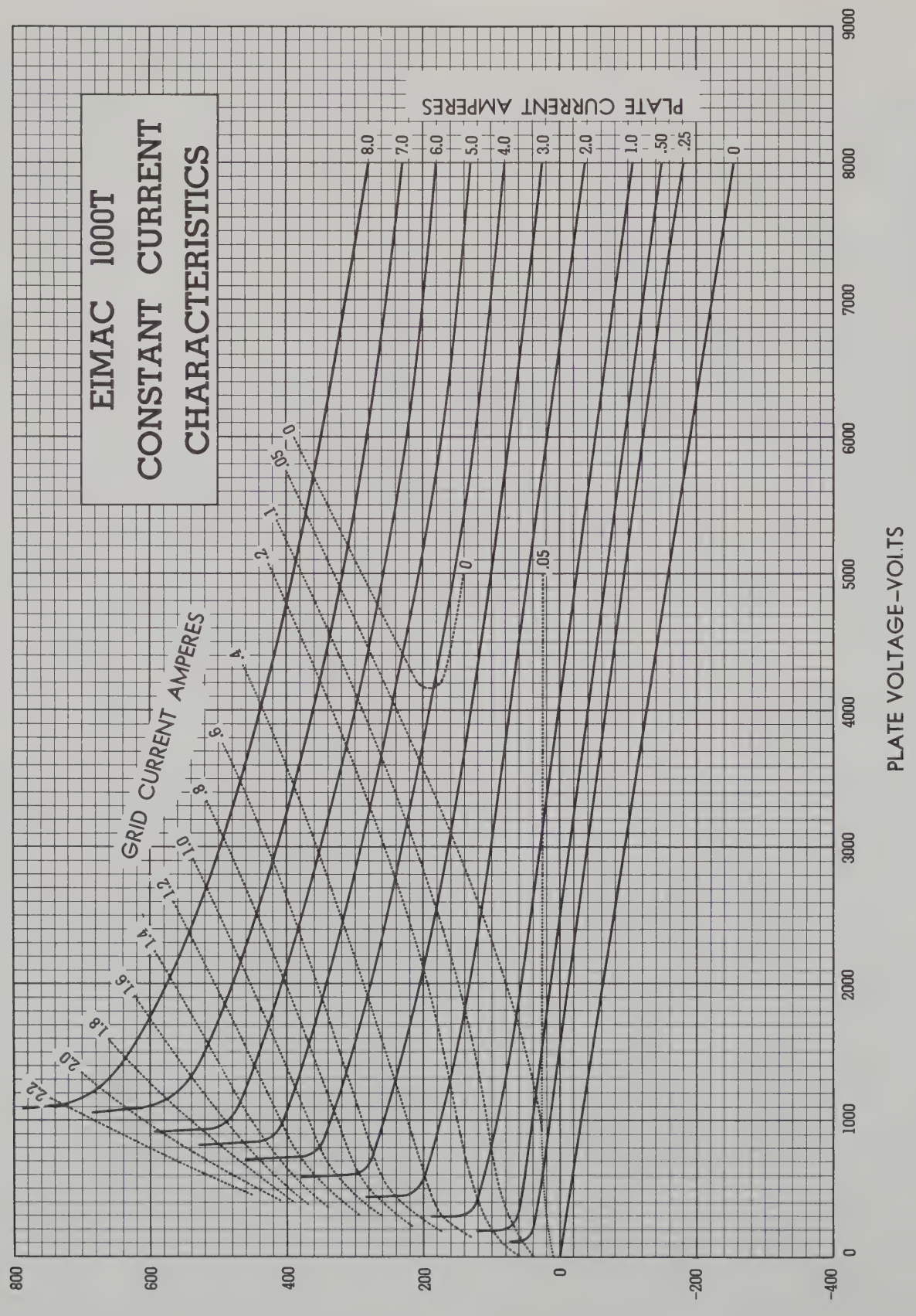
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000, and 6000 volts respectively.









Printed in U.S.A. 924

EIMAC

A Division of Varian Associates

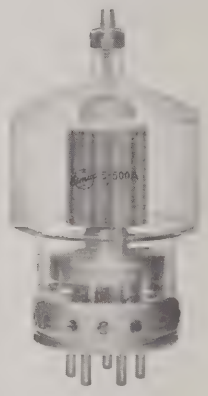
5-500A

RADIAL-BEAM POWER PENTODE

•

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 5-500A is a compact, ruggedly constructed radial-beam power pentode having a maximum plate dissipation rating of 500 watts. It is intended for use as an amplifier, oscillator or modulator. The high plate current rating, low grid-plate capacitance and low driving power requirements permit maximum power capability to be combined with circuit simplicity and economic driver requirements.



The Eimac 5-500A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope and over the plate seal. Cooling may be greatly simplified by the use of the Eimac SK-400 or SK-410 Air System Socket and the accompanying Eimac SK-426 glass chimney. These sockets are designed to maintain the correct balance of cooling air between the component parts of the tube.

The suppressor element of the 5-500A terminates at the tube base shell, and is designed to be operated at ground (zero) potential. The base shell must be grounded by means of suitable spring clips.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten, balanced			
Voltage		10.0 volts	
Current		10.2 amperes	
Grid-Screen Amplification Factor (Average)		5.5	
Direct Interelectrode Capacitances, Grounded Cathode	*Min.*	*Max.*	
Grid-Plate	—	.10	pf
Input	15.0	19.0	pf
Output	9.5	12.0	pf

MECHANICAL

Base	see drawing
Basing	see drawing
Mounting Position	Vertical, base up or down
Cooling	Radiation and forced air
Recommended Heat Dissipating Connector	Eimac HR-6
Recommended Socket	Eimac SK-400 or SK-410 Air System Socket
Recommended Chimney	Eimac SK-426
Maximum Overall Dimensions	
Length	7.00 inches
Diameter	3.56 inches
Net Weight	11 ounces
Shipping Weight	2.5 pounds

NOTE: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

(Effective 11-15-65) Copyright 1965 by Varian Associates

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 Max. Volts
D-C SCREEN VOLTAGE	600 Max. Volts
D-C SUPPRESSOR VOLTAGE	100 Max. Volts
D-C PLATE CURRENT	450 Max. ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts
GRID DISSIPATION	12 Max. Watts

TYPICAL OPERATION

D-C Plate Voltage	2500	3000	4000 Volts
D-C Screen Voltage	500	500	500 Volts
D-C Grid Voltage	—210	—220	—240 Volts
D-C Suppressor Voltage	0	0	0 Volts
D-C Plate Current	405	432	450 ma
D-C Screen Current	55	65	65 ma
D-C Grid Current	28	35	38 ma
Screen Dissipation	27.5	32.5	33 Watts
Grid Dissipation	2.8	3.8	5.0 Watts
Peak R-F Grid Input Voltage	310	330	365 Volts
MF Driving Power*	8.7	12	14 Watts
Plate Power Input	1015	1300	1800 Watts
Plate Dissipation	265	495	500 Watts
Plate Power Output	750	805	1300 Watts

*Driving Power increases as frequency is increased.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1, Grounded Cathode, one tube

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 Max. Volts
DC SCREEN VOLTAGE	1000 Max. Volts
DC SUPPRESSOR VOLTAGE	100 Max. Volts
DC PLATE CURRENT	450 Max. ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts

TYPICAL OPERATION (Frequencies below 30 Mc.)
Peak-Envelope or Modulation-Crest Conditions.
Adjusted for minimum distortion.

DC Plate Voltage	2000	3000	4000 Volts
DC Screen Voltage	750	750	750 Volts
DC Suppressor Voltage	0	0	0 Volts
DC Control Grid Voltage*	—100	—112	—121 Volts
Zero-Signal DC Plate Current	150	100	80 mA
Single-Tone DC Plate Current	338	320	322 mA
Two-Tone DC Plate Current	252	221	212 mA
Single-Tone DC Screen Current	31	26	24 mA
Two-Tone DC Screen Current	15	12	10 mA
Peak RF Grid Voltage	100	112	121 Volts
Useful Output Power	395	612	832 Watts
Resonant Load Impedance	3600	5800	7700 Ohms
Third Order Intermodulation Products**	—52	—33	—28 db
Fifth Order Intermodulation Products**	—49	—41	—37 db

*1. Adjust to the specified zero-signal plate current.

**2. Equal or better than stated for all signal levels up to indicated useful output power. Reference to one tone of a two-tone test signal.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified.)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 Volts
DC SCREEN VOLTAGE	600 Volts
DC SUPPRESSOR VOLTAGE	100 Volts
DC GRID VOLTAGE	—500 Volts
DC PLATE CURRENT	340 ma
PLATE DISSIPATION	330 Watts
SCREEN DISSIPATION	35 Watts
GRID DISSIPATION	12 Watts

TYPICAL OPERATION

DC Plate Voltage	2700	3100	3500 Volts
DC Screen Voltage	450	470	500 Volts
DC Grid Voltage	—270	—310	—300 Volts
DC Suppressor Voltage	0	0	0 Volts
DC Plate Current	285	260	305 ma
DC Screen Current	68	50	55 ma
DC Grid Current	20	15	18 ma
Screen Dissipation	31	23	27 Watts
Peak A-F Screen Voltage Approx. (100% Modulation)	350	330	350 Volts
Peak R-F Grid Voltage	355	385	375 Volts
MF Grid Driving Power	7	6	7 Watts
Plate Dissipation	160	220	280 Watts
Plate Power Output	580	580	780 Watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	4000 Max. Volts
D-C SCREEN VOLTAGE	1000 Max. Volts
D-C SUPPRESSOR VOLTAGE	100 Max. Volts
MAX-SIGNAL D-C PLATE CURRENT	450 ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts
GRID DISSIPATION	12 Max. Watts

TYPICAL OPERATION CLASS AB_1
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	3000	4000 Volts
D-C Screen Voltage	750	750 Volts
D-C Suppressor Voltage	0	0 Volts
D-C Grid Voltage (approx.)*	—112	—121 Volts
Zero-Signal D-C Plate Current	200	160 ma
Max-Signal D-C Plate Current	640	645 ma
Zero-Signal D-C Screen Current	0	0 ma
Max-Signal D-C Screen Current	52	48 ma
Effective Load, Plate-to-plate	11,600	15,400 Ohms
Peak A-F Grid Input Voltage (per tube)	112	121 Volts
Driving Power	0	0 Watts
Max-Signal Plate Power Output	1224	1664 Watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

If it is desired to operate this tube under conditions widely different from those given under "Typical Operation," possibly exceeding the maximum ratings given for CW service, write Eimac, A Division of Varian Associates, for information and recommendations.

APPLICATION

MECHANICAL

MOUNTING—The 5-500A must be mounted vertically, base up or base down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the Eimac SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the Eimac HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING—Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the Eimac SK-400 or SK-410 Air-System Sockets and SK-426 chimney are used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System socket is not used, provision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive laquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

ELECTRICAL

FILAMENT VOLTAGE—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 10.0 volts. Variations in filament voltage must be kept within the range of 9.5 to 10.5 volts.

The 5-500A features a balanced filament structure to help the designer meet FCC hum and noise specifications in AM service.

BIAS VOLTAGE — The d-c bias voltage for the 5-500A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE—The d-c screen voltage for the 5-500A should not exceed 800 volts in r-f applications. In audio applications a maximum d-c screen voltage of 1,000 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

PLATE VOLTAGE—The plate-supply voltage for the 5-500A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the d-c plate-supply voltage should not exceed 3200 volts, except below 30 Mc., intermittent service, where 4000 volts may be used.

GRID DISSIPATION — Grid dissipation for the 5-500A should not be allowed to exceed 12 watts. Grid dissipation may be calculated from the following expression,

$$Pg = \varepsilon cmp Ic$$

where Pg = Grid Dissipation
εcmp = Peak positive grid to cathode voltage, and
Ic = D-C grid current

εcmp may be measured by means of a suitable peak voltmeter connected between filament and grid.

SCREEN DISSIPATION — The power dissipated by the screen of the 5-500A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION—Under normal operating conditions, the plate dissipation of the 5-500A should not be allowed to exceed 500 watts.

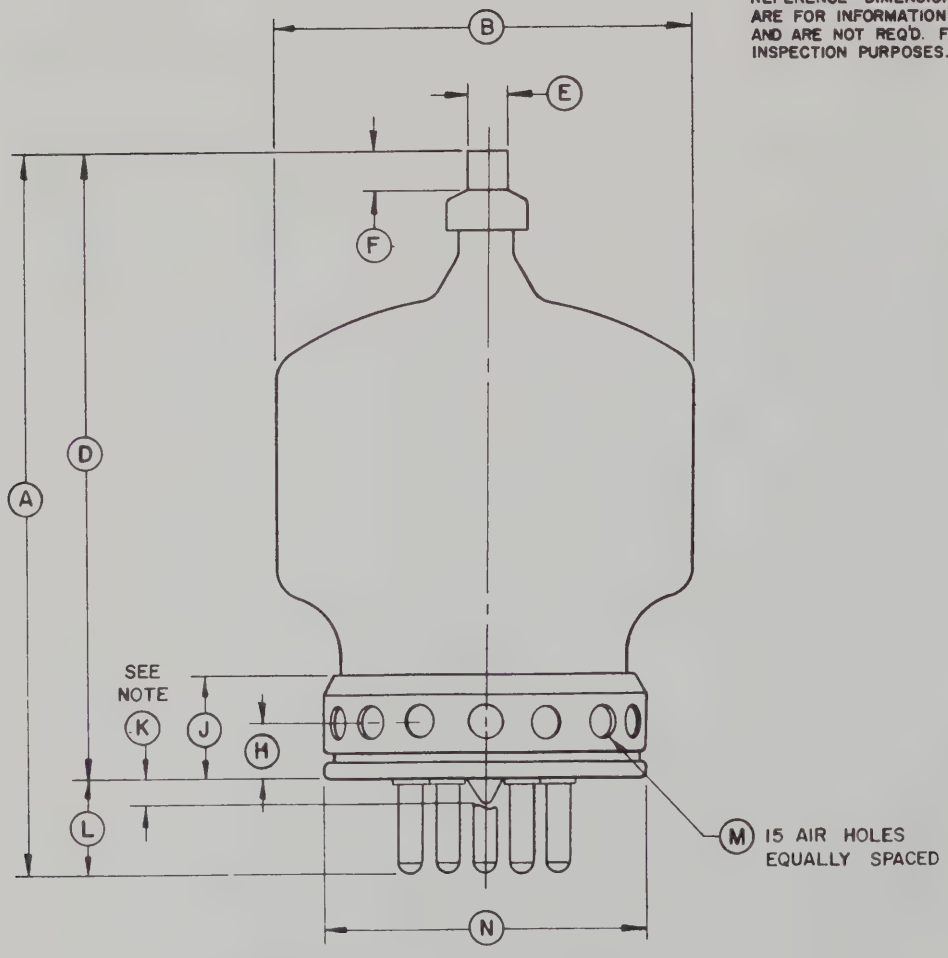
In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 330 watts. The plate dissipation may rise to 500 watts under 100% sinusoidal modulation.

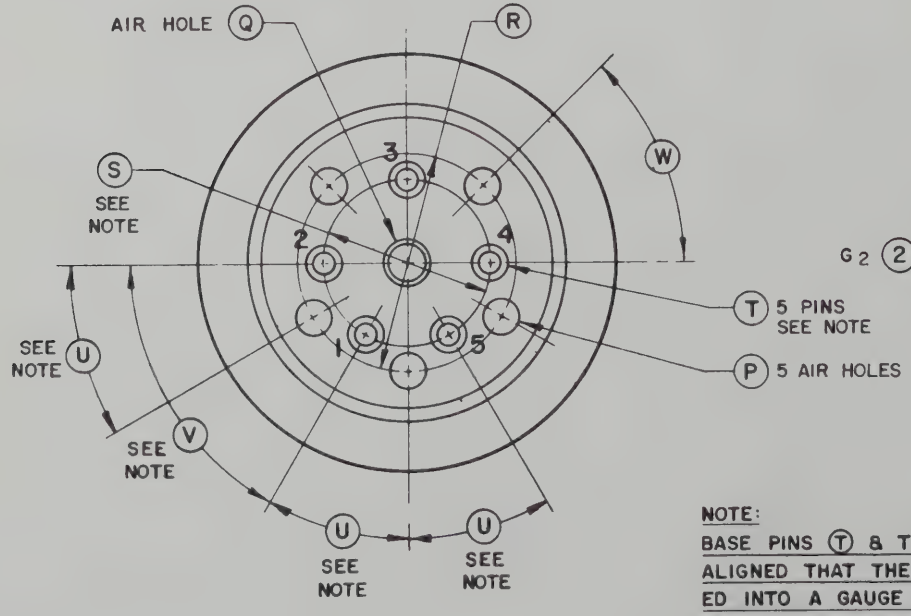
Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

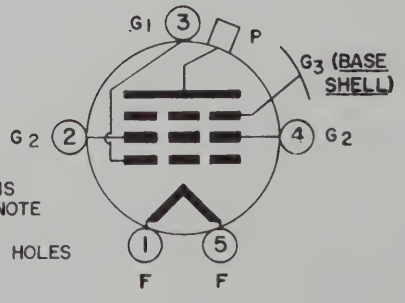
General information pertaining to the operation of the 5-500A may be found in Application Bulletin No. 8, "The Care and Feeding of Power Tetrodes." This Bulletin is available upon request.

REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQ'D. FOR INSPECTION PURPOSES.

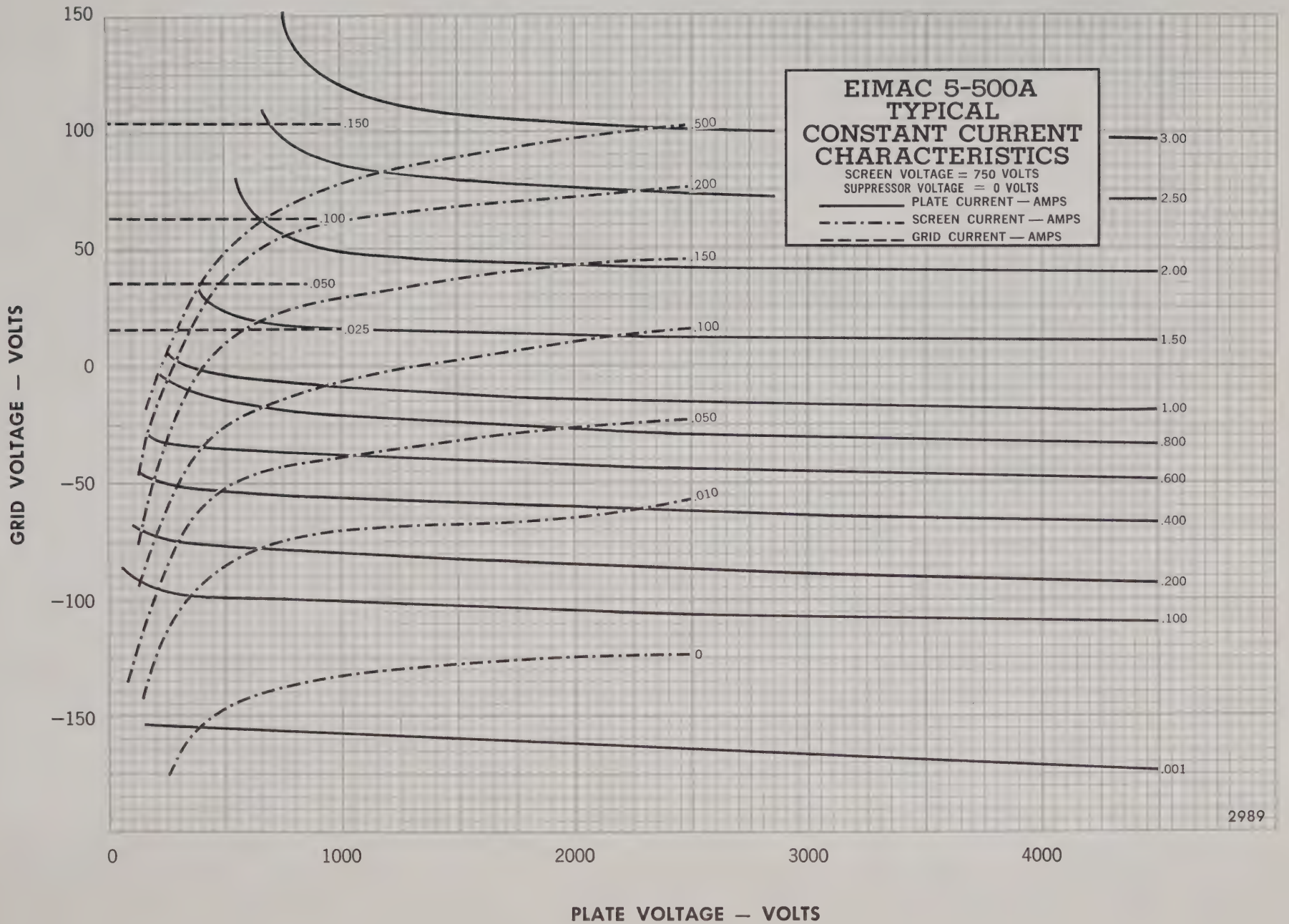
DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN	MAX.	REF.
A	6.500	7.000	
B		3-9/16 D.	
D	5.750	6.250	
E	.350 D.	.365 D.	
F	21/64		
H			7/16
J			31/32
K		1.1/4	
L			3/4
M			1/4 D.
N		2-3/4 D.	
P			5/16 D.
Q			1/2 D.
R			1-5/8 D.
S			1-1/4 D.P.C.
T	.185 D.	.191 D.	
U			30°
V			60°
W			45°

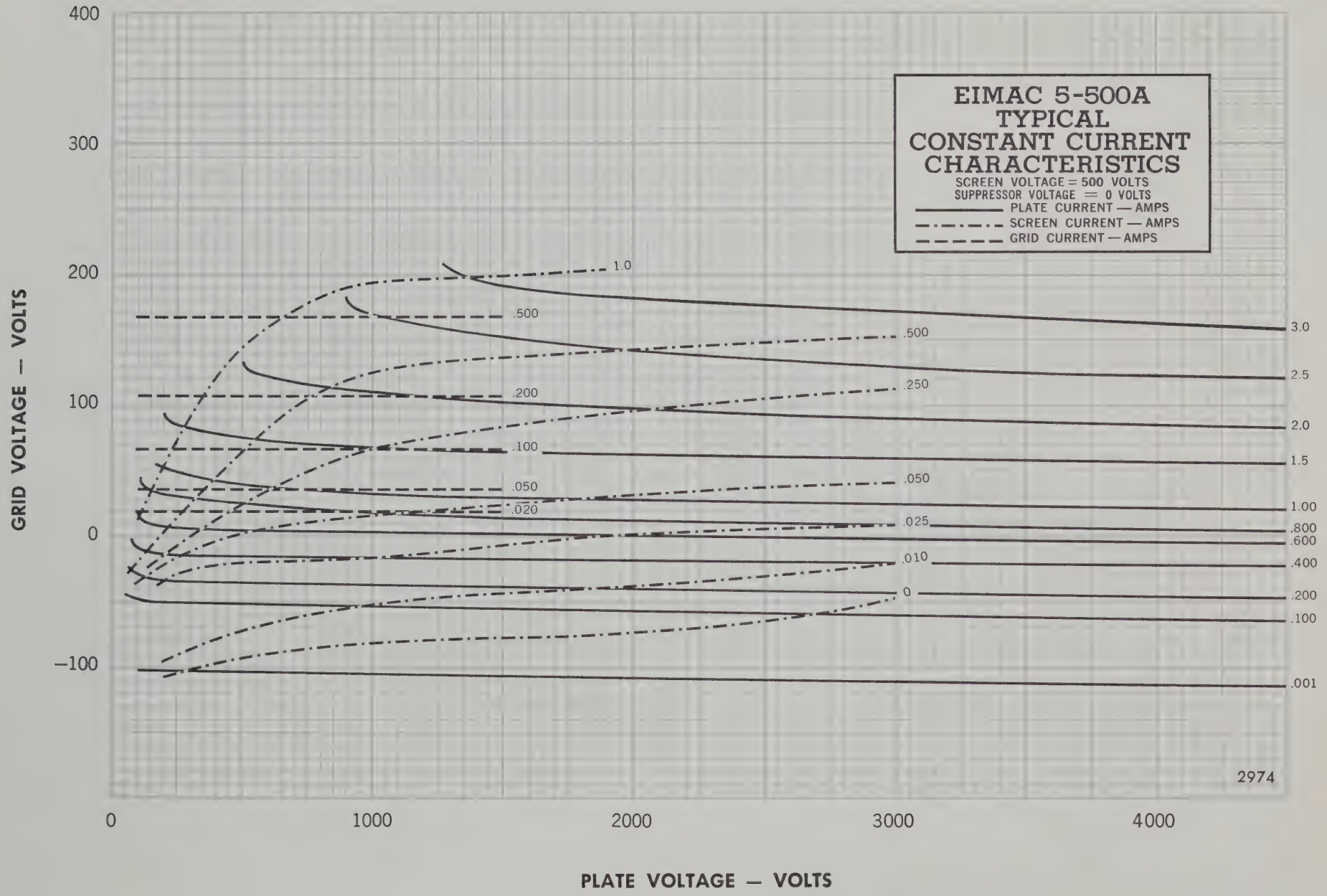






NOTE:
BASE PINS (T) & TUBULATION (K) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 RESPECTIVELY LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS (V), (U), (S).


EIMAC 5-500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
150
100
50
0
−50
−100
−150
0
1000
2000
3000
4000
.150
.100
.050
.025
.500
.200
.150
.100
.050
.010
0
3.00
2.50
2.00
1.50
1.00
.800
.600
.400
.200
.100
.001
2989


EIMAC 5-500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
400
300
200
100
0
−100
GRID VOLTAGE — VOLTS
0
1000
2000
3000
4000
PLATE VOLTAGE — VOLTS
1.0
.500
.200
.100
.050
.020
.500
.250
.050
.025
.010
0
3.0
2.5
2.0
1.5
1.00
.800
.600
.400
.200
.100
.001
2974

EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

X-6006

SPACE VEHICLE DOCKING LIGHT

The Eimac X-6006 Space Vehicle Docking Light has been developed to fill the need for a reliable reference instrument in space missions which involve orbital rendezvous, docking, extravehicular activity, and similar functions. The X-6006 Docking Light is designed to withstand the extreme shock and acceleration of launch and the rigors of orbital space flight. The device is capable of enduring extremes of thermal shock, ambient temperature, vibration, sound pressure, and altitude.



The Eimac X-6006 Space Vehicle Docking Light is available in three brilliant colors: X-6006-7 is red, X-6006-9 is green, and X-6006-11 is yellow.

CHARACTERISTICS

	Min.	*Nom.*	*Max.*	
ELECTRICAL				
Voltage	5	6	7	Volts
Current		.7		Amperes
OPTICAL				
Light Intensity	1	2		SCP
Color (Per MIL C 25050, Class 1)				Aviation Red Aviation Green Aviation Yellow
THERMAL				
Lens Temperature				70°F to 683°F in 65 seconds
Ambient Temperature				—100°F to +200°F

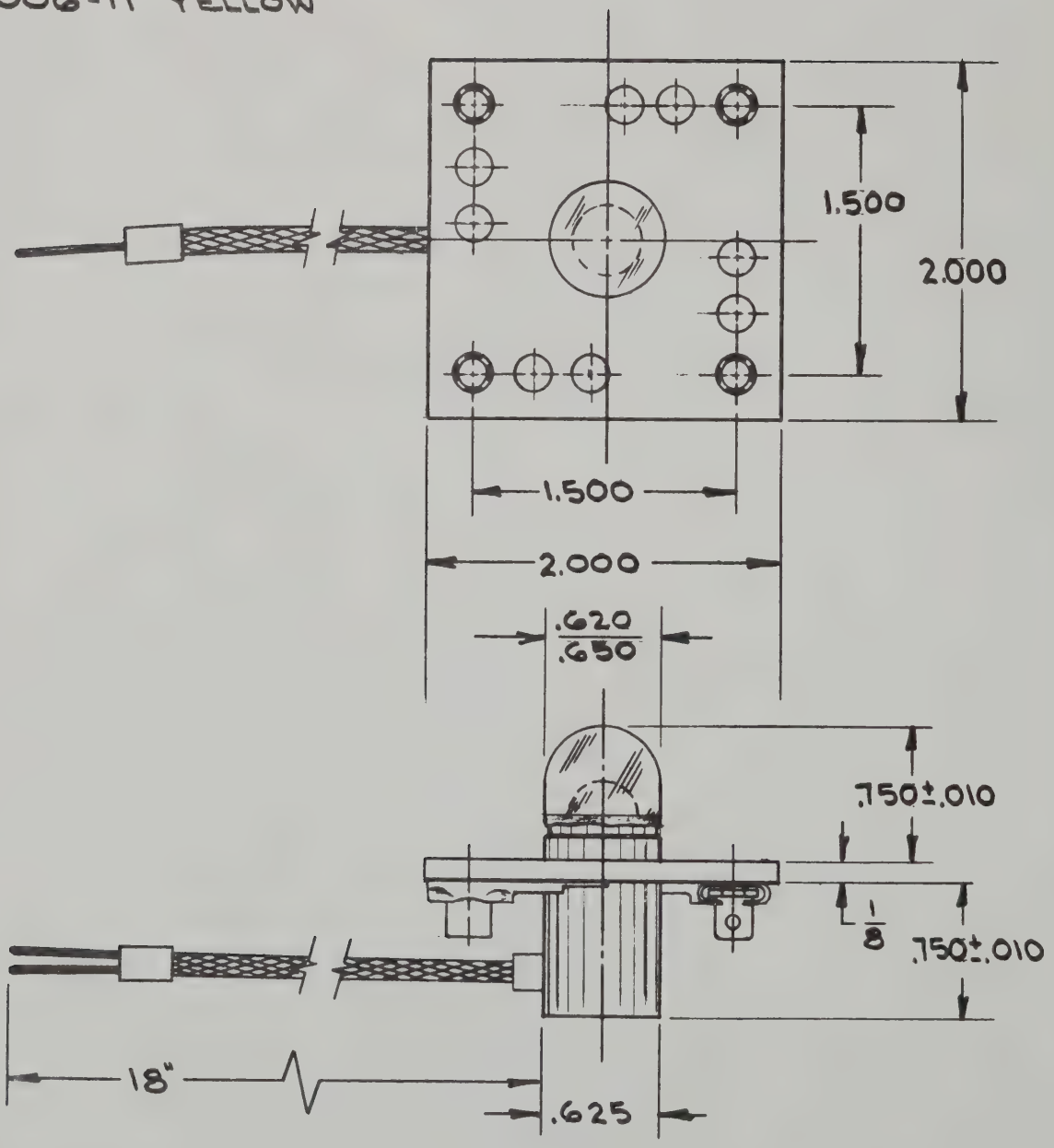
MECHANICAL	*Freq.*	*Level*
Vibration		
Sustained Sinusoidal	5-20 CPS	½ Inch P to P
	20-400	5 G's
	400-1500	7.5
	1500-3000	20
Randon	15-2000	.10 G^2/CPS
Acoustic	37-9600	158 DB Overall

SHOCK	40 G's, 6 Milliseconds
PRESSURE	760 to 10^{-5} mm torr

(Effective 10-1-65) Copyright 1965 by Varian Associates

Printed in U.S.A.

NOTE
X6006-7 RED
X6006-9 GREEN
X6006-11 YELLOW

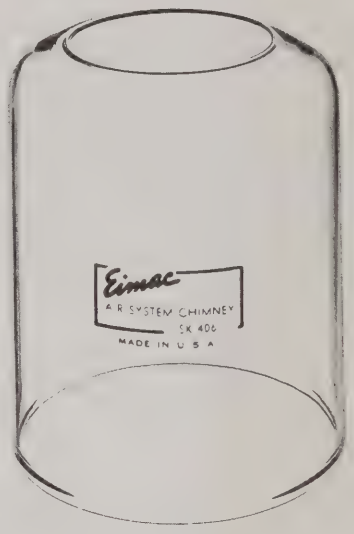


X-6006 — SPACE VEHICLE DOCKING LIGHT

EIMAC
A Division of Varian Associates
SAN CARLOS, CALIFORNIA

SK-406
SK-416
SK-426

AIR-SYSTEM CHIMNEYS



The SK-406, SK-416, and SK-426 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat-radiating connector.

MATERIALS

The SK-406, SK-416, and SK-426, Air-System Chimneys are made of sturdy, heat resistant Pyrex glass. The bottom edge is flat for a tight seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

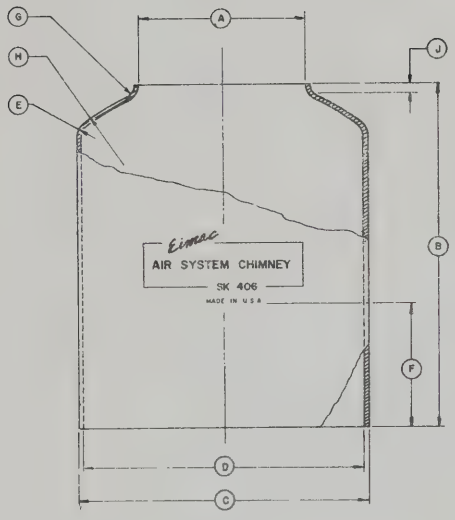
These chimneys are designed for installation above the chassis or plenum that holds the companion Air-System Socket. The four spring clips supplied with the SK-400 (eight clips are supplied with the SK-410) socket also act as retaining clips for the chimney. After the socket and spring clips are installed, the chimney is pressed down over the spring clips.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-406	4-125A 4-250A 4-400A 4PR125A 4PR400A	SK-400 SK-410
SK-416	3-400Z	
SK-426	5-500A	

Net Weight - - - - - - - - - - - - - - - - SK-406 — 8 ounces
SK-416 — 7 ounces
SK-426 — 8 ounces

(Revised 11-1-65) © Copyright 1963, 1965 by Varian Associates Printed in U.S.A.

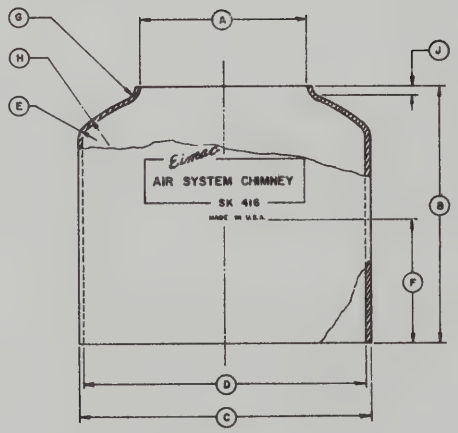


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.312	2.438	
B	4.813	5.000	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.625	1.875	
G		.188	
H			3.250
J		.188	.125

SK-406

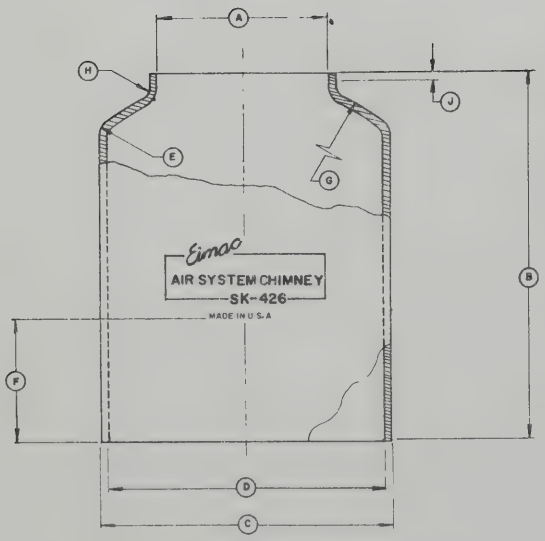


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.312	2.438	
B	4.000	4.188	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.187	1.312	
G		.188	
H			3.250
J		.188	.125

SK-416



DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX	NOM.
A	2.312	2.438	
B	5.063	5.250	
C		4.125	4.022
D	3.718	3.906	
E			.250
F	1.625	1.875	
G			3.250
H			.188
J			.125

SK-426

TECHNICAL DATA

SK-510

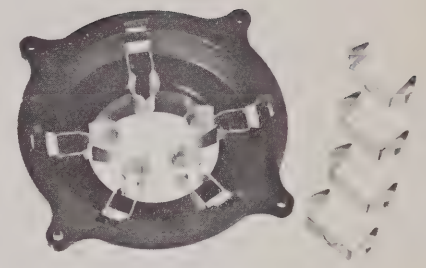
AIR-SYSTEM SOCKET

The EIMAC SK-510 is an Air-System Socket recommended for use with the tube types listed below, or other types having the same special five-pin base. Two different glass Air-Chimneys are available from EIMAC for use with the SK-510, depending on the tube type used.

The SK-510 is especially recommended for pressurized-chassis installations. Cooling air then cools the base, envelope, and plate-seal areas of the tube, when directed by the proper Air-Chimney.

Contact terminals are provided for all five of the tube base connections, with the anode connection made separately at the top of the tube.

The SK-510 and its contact assemblies are humidity and salt-spray resistant.



BASE CONNECTIONS, MATERIALS, AND FINISHES

The socket shell or body is of a molded plastic with excellent insulation characteristics to match the tube types for which this unit was designed. The base contact terminals are made of beryllium-copper and are silver plated. A set of four clips are provided, for locating and holding the recommended Air-Chimney concentric with the tube. These clips are double-ended so they will ground the metal base shell of some tube types which require this. The clips are also made of beryllium copper but are cadmium plated.

NET WEIGHT (Approximate) . . . . . 6.5 oz; 184 gms

INSTALLATION

The SK-510 Air-System Socket can be mounted on a chassis deck, partition, or pressurized compartment. Mounting is accomplished by cutting a 3-3/4 inch hole in the mounting surface, placing the socket below the hole, and fastening it into place with four 6-32 machine screws (not supplied) through the four mounting holes in the "ears" of the socket body.

The socket also has a 2-3/8 inch O.D. round neck extending 3/4 inch below the main socket body which provides a means for connecting a standard air duct to the base.

The following listing shows the EIMAC tube types which may be used with the SK-510 and the recommended Air-Chimney.

TUBE TYPE	AIR CHIMNEY
3-1000Z (8164)	SK-516
4-1000A (8166)	SK-506
4PR1000A (8189)	SK-506
4PR1000B (8189W)	SK-506
TYPE 279	SK-506
TYPE 284	SK-506
TYPE 8960	SK-506

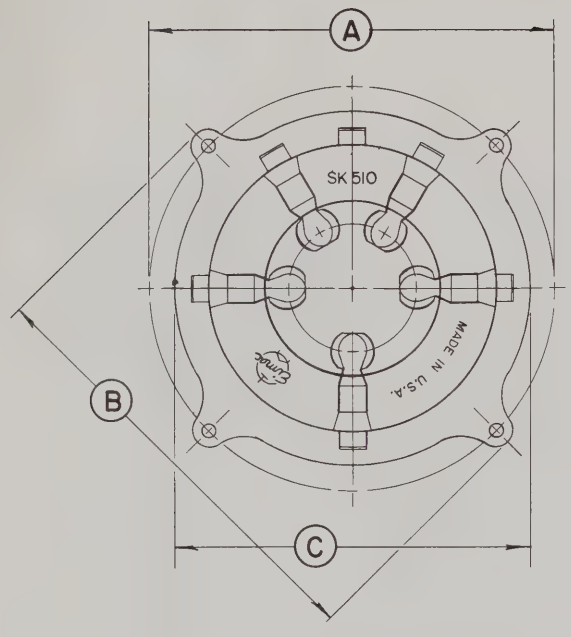
(Revised 3-15-75) © 1963, 1966, 1975 by Varian

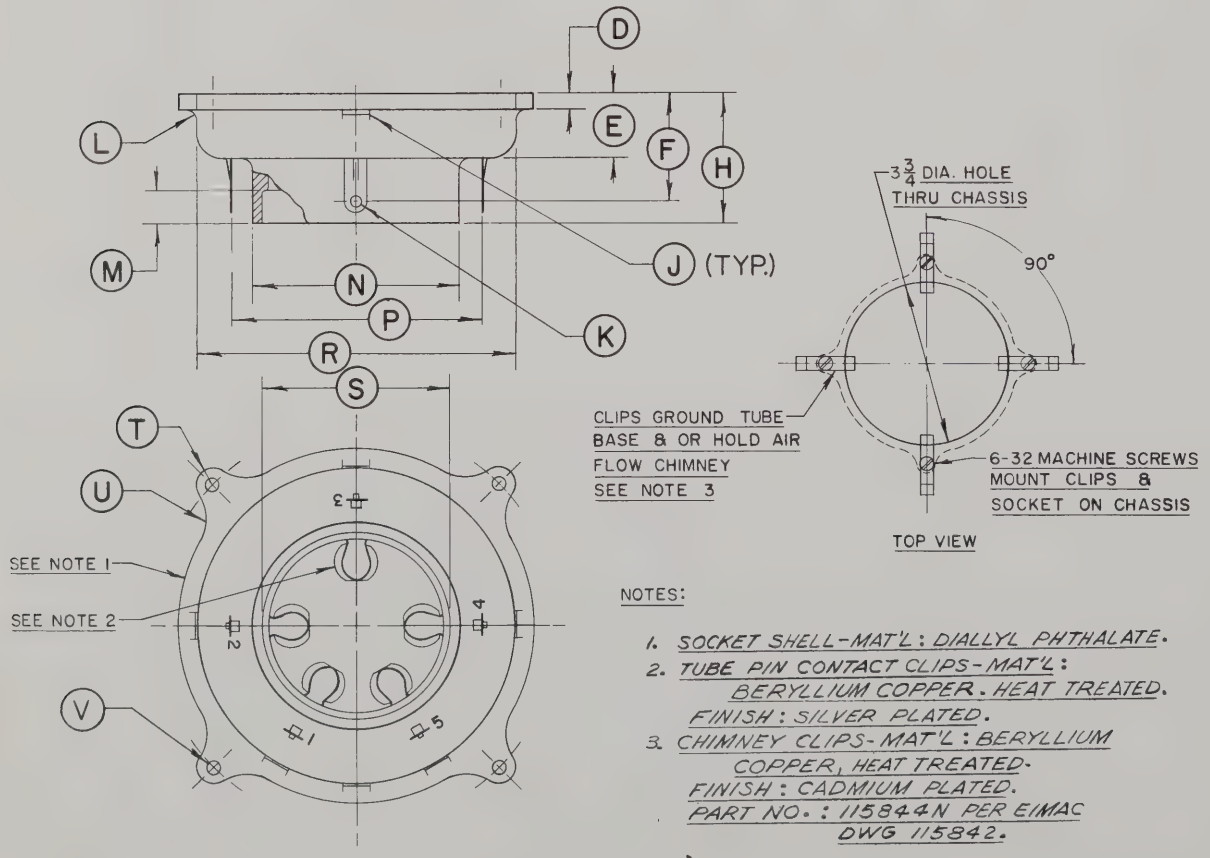
Printed in U.S.A.

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.593*	4.656*	- -	116.7	118.3	- -
B	4.968	5.031	- -	126.2	127.8	- -
C	4.031*	4.093*	- -	102.4	104.0	- -
D	0.156	0.218	- -	3.96	5.54	- -
E	0.718	0.781	- -	18.24	19.83	- -
F	- -	- -	1.250	- -	- -	31.75
H	1.468	1.531	- -	37.29	38.89	- -
J**			- -			- -
K	0.093*	0.156*	- -	2.36*	3.96*	- -
L	0.093R	0.156R	- -	2.36R	3.96R	- -
M	0.343	0.406	- -	8.71	10.31	- -
N	2.343*	2.406*	- -	59.51*	61.11*	- -
P	- -	- -	2.890	- -	- -	73.41
R	3.593*	3.656*	- -	91.26*	92.86*	- -
S	2.140*	2.203*	- -	54.36*	55.96*	- -
T	- -	- -	0.187R	- -	- -	4.75R
U	- -	- -	0.500R	- -	- -	12.70R
V	0.139*	0.152*	- -	3.53*	3.86*	- -

* DIAMETER

** 0.031 x 0.281, 0.093 x 0.343 (IN.)
0.79 x 7.14, 2.36 x 8.71 (MIL.)





NOTES:

1. SOCKET SHELL-MAT'L: DIALLYL PHTHALATE.
2. TUBE PIN CONTACT CLIPS-MAT'L: BERYLLIUM COPPER. HEAT TREATED. FINISH: SILVER PLATED.
3. CHIMNEY CLIPS-MAT'L: BERYLLIUM COPPER, HEAT TREATED. FINISH: CADMIUM PLATED. PART NO.: 115844N PER EIMAC DWG 115842.

varian

1 May 1979

TO EIMAC TUBE MANUAL HOLDERS

The enclosed new or revised data sheets are to be inserted in the appropriate section of your EIMAC Tube Manual, Volumes I & II. Please retain this transmittal sheet in the General section of your manuals until an updated Table of Contents is distributed later in the year.

VOLUME I	INSERT	FOLLOWING	REMOVE
Triodes			
3-500Z	1/02/79		6/01/77
3CX2500A3/F3/H3	3/01/79		
3CX2500A3			3/01/67
3CX2500F3			3/01/67
3CX2500H3			2/01/71
VOLUME II			
Tetrodes			
4CX600J/JA	8/01/78		8/15/71
8973	7/01/78	8959	---
Other Products			
CV-2200	3/01/79	CV-850	
SK-800B/806/810B/811/890B/801	3/01/79		
SK800B/806			4/09/64
SK810B/806			6/01/67
SK1500A, 1510A, 1511	3/15/79	SK-1400A/ SK-1470A	---

William I. Orr

William I. Orr, Manager
Technical Data

W10/a

Enclosures

3-500Z

HIGH-MU
POWER TRIODE

TECHNICAL DATA

The EIMAC 3-500Z is a compact power triode intended to be used as a zero-bias Class AB2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3-500Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

FILAMENT: Thoriated Tungsten (see FILAMENT OPERATION)	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.6 A
Amplification Factor (Average)	130
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	8.3 pF
Output	0.07 pF
Feedback	4.7 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Input	8.3 pF
Output	4.7 pF
Feedback	0.07 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division should be consulted before using this information for final equipment design.
2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.10 in; 154.94 mm
Diameter	3.44 in; 87.33 mm
Net Weight	7.0 oz; 198.5 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	5 Pin Special

(Revised 1-2-79 © 1968, 1970, 1973, 1977, 1979 by Varian

Printed in U.S.A.

Recommended Socket ..... EIMAC SK-410
Recommended Chimney ..... EIMAC SK-406
Recommended Hear-Dissipating Connector;
Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

(Frequencies to 110 MHz)

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE ..... 4000 VOLTS
DC PLATE CURRENT ..... 0.4 AMPERE
PLATE DISSIPATION ..... 500 WATTS
GRID DISSIPATION ..... 20 WATTS

1. Zener diode positive bias used at plate potentials of 3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "Two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of circuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two tone signal.

TYPICAL OPERATION
Class AB_2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[3,4] ..	400	400	400	400	400	mAdc
Two-Tone Plate Current	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	Ω
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	---	---	---	-46	-45	db
Driving Impedance	94	102	100	115	115	Ω
Maximum Signal Driving Power[2] ..	49	49	46	46	46	W

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN, CATHODE DRIVEN

Class AB_2 and C Telegraphy or FM
(Key-Down Conditions)
(Frequencies to 110 MHz)

MAXIMUM RATINGS:

DC PLATE VOLTAGE ..... 4000 VOLTS
DC PLATE CURRENT ..... 0.35 AMPERE
PLATE DISSIPATION ..... 500 WATTS
GRID DISSIPATION ..... 20 WATTS

TYPICAL OPERATION

	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	-10	-75	-10	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	110	187	95	200	v
Approx. Driving Power .	14	22	35	81	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	300	305	W
Useful Output Power ...	720	850	700	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE ..... 3000 VOLTS
DC PLATE CURRENT ..... 0.275 AMPERE
PLATE DISSIPATION[1] ..... 330 WATTS
GRID DISSIPATION[2] ..... 20 WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage ..... 3000 Vdc
Grid Voltage ..... -100 Vdc
Plate Current ..... 275 mAdc
Grid Current[1] ..... 120 mAdc
Peak rf Grid Voltage[1] ..... 200 v
Calculated Driving Power ..... 25 W
Plate Input Power ..... 825 W
Plate Dissipation ..... 185 W
Plate Output Power ..... 640 W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_2, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE[1]	4000 VOLTS
DC PLATE CURRENT	0.4 AMPERE
PLATE DISSIPATION	500 WATTS
GRID DISSIPATION	20 WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	3000 Vdc
Grid Voltage	0 Vdc
Zero-Signal Plate Current[2]	300 mAdc
Max. Signal Plate Current	770 mAdc
Max. Signal Grid Current[2]	244 mAdc
Peak af Grid Voltage[3]	100 v
Peak Driving Power[4]	25 w
Plate Input Power	2310 W
Max. Signal Plate Dissipation	890 W
Plate Output Power	1420 W
Load Resistance (plate to plate)	8600 Ω

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurement. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	13.8	15.0	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	6.5	10.0	pF
Output	---	0.18	pF
Feedback	4.2	5.2	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	6.5	10.0	pF
Output	4.2	5.2	pF
Feedback	---	0.18	pF
Zero Signal Plate Current: (Ec = 0 Vdc, Eb = 2500 Vdc)	90	180	mAdc

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 3-500Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

SOCKET - The EIMAC SK-410 air system socket and SK-406 chimney are recommended for use with the 3-500Z. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the EIMAC SK-410 is employed, the user should assure himself that strong lateral pressure is not applied to the tube base pins. Otherwise, even though the base of the tube is reinforced, damage to the base seals may result.

CAUTION-GLASS IMPLOSION - The EIMAC 3-500Z is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will

result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. Air flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches-H_2O)
300	6.6	0.023
400	10.3	.052
500	13.0	.082

The anode of the 3-500Z operates at a visibly red color at its maximum rated dissipation of 500 watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500Z tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3-inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon.

Suitable products are manufactured by the Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, New Jersey 07080.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate voltages over 2500 since plate dissipation may be exceeded. A zener diode placing positive bias on the cathode or other constant voltage source may be used to reduce zero signal plate current at plate potentials over 2500 volts.

CLASS-C OPERATION - Although specifically designed for linear amplifier service, the 3-500Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-500Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-resistor bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 3-500Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

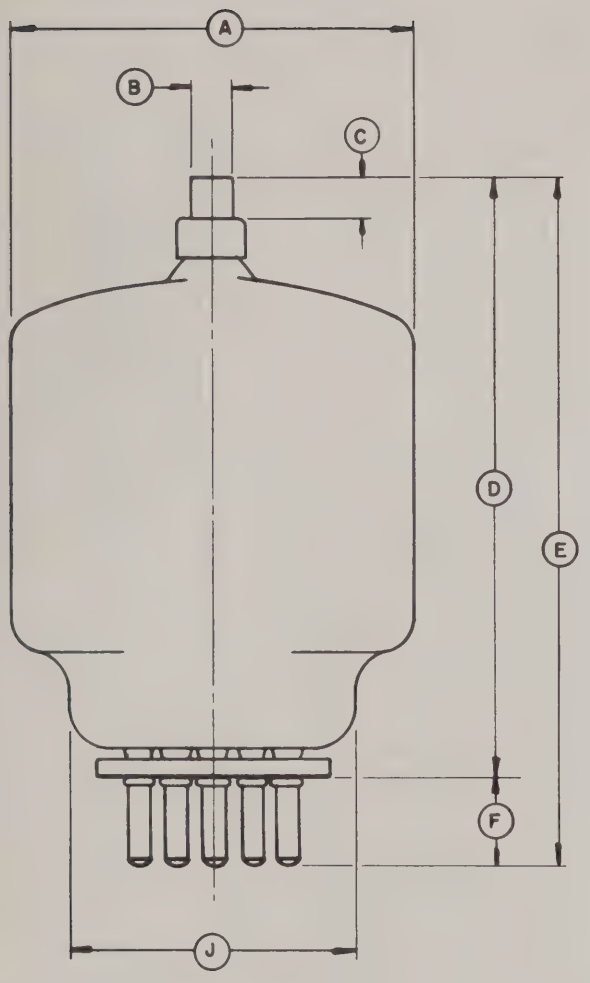
For best tube life the inrush current to the filament should be limited to two times normal current during turn-on. This will minimize thermal stress on the thoriated-tungsten filament wire, which can cause internal tube geometry changes with repeated cycling.

CAUTION-HIGH VOLTAGE - Operating voltage for the 3-500Z can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERMODULATION DISTORTION - Typical operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted.

INPUT CIRCUIT - When the 3-500Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of five or more.

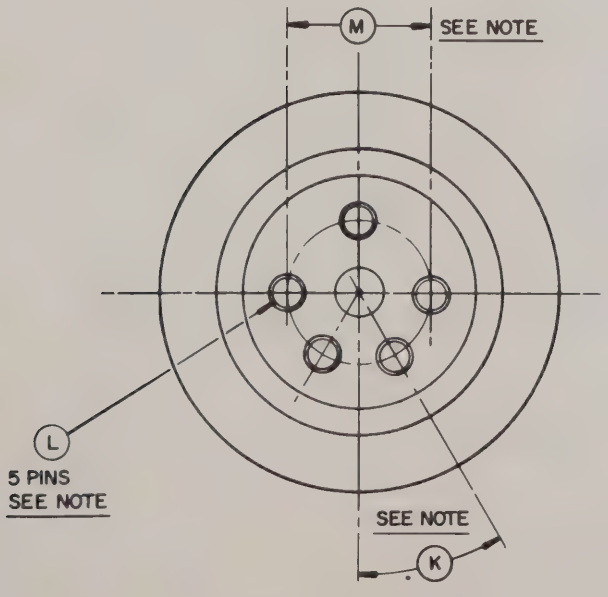
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070 for information and recommendation.

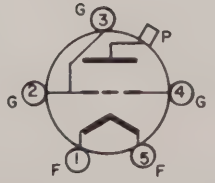


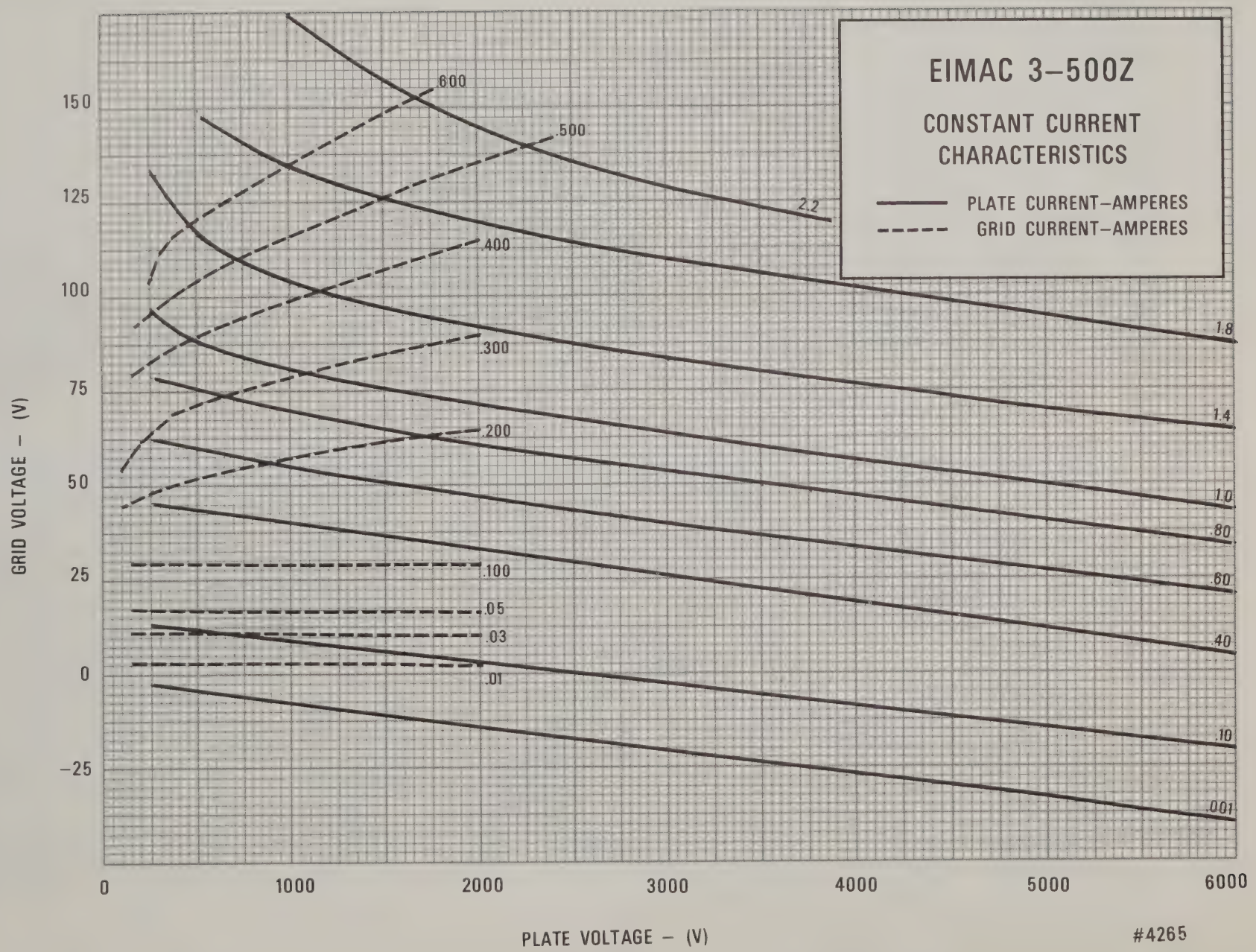
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		3.438			87.33	
B	.350	.365		8.89	9.27	
C	.328	.359		8.33	9.12	
D		5.200			132.1	
E	5.500	6.100		139.7	154.94	
F	.700			17.78		
G						
H						
I						
J		2.500			63.5	
K			30°			
L	.185	.191		4.7	4.85	
M			1.250			31.75

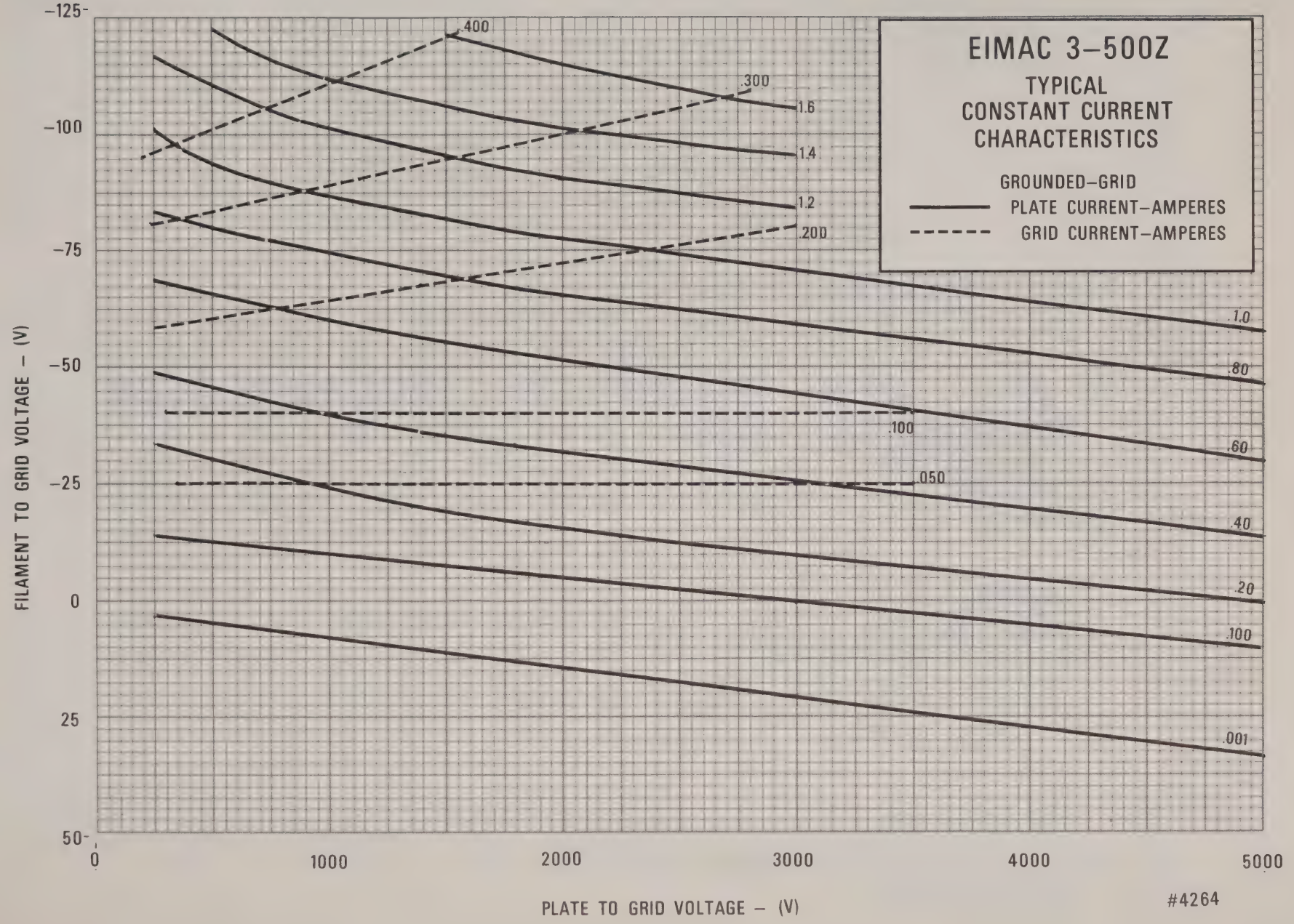
NOTES:

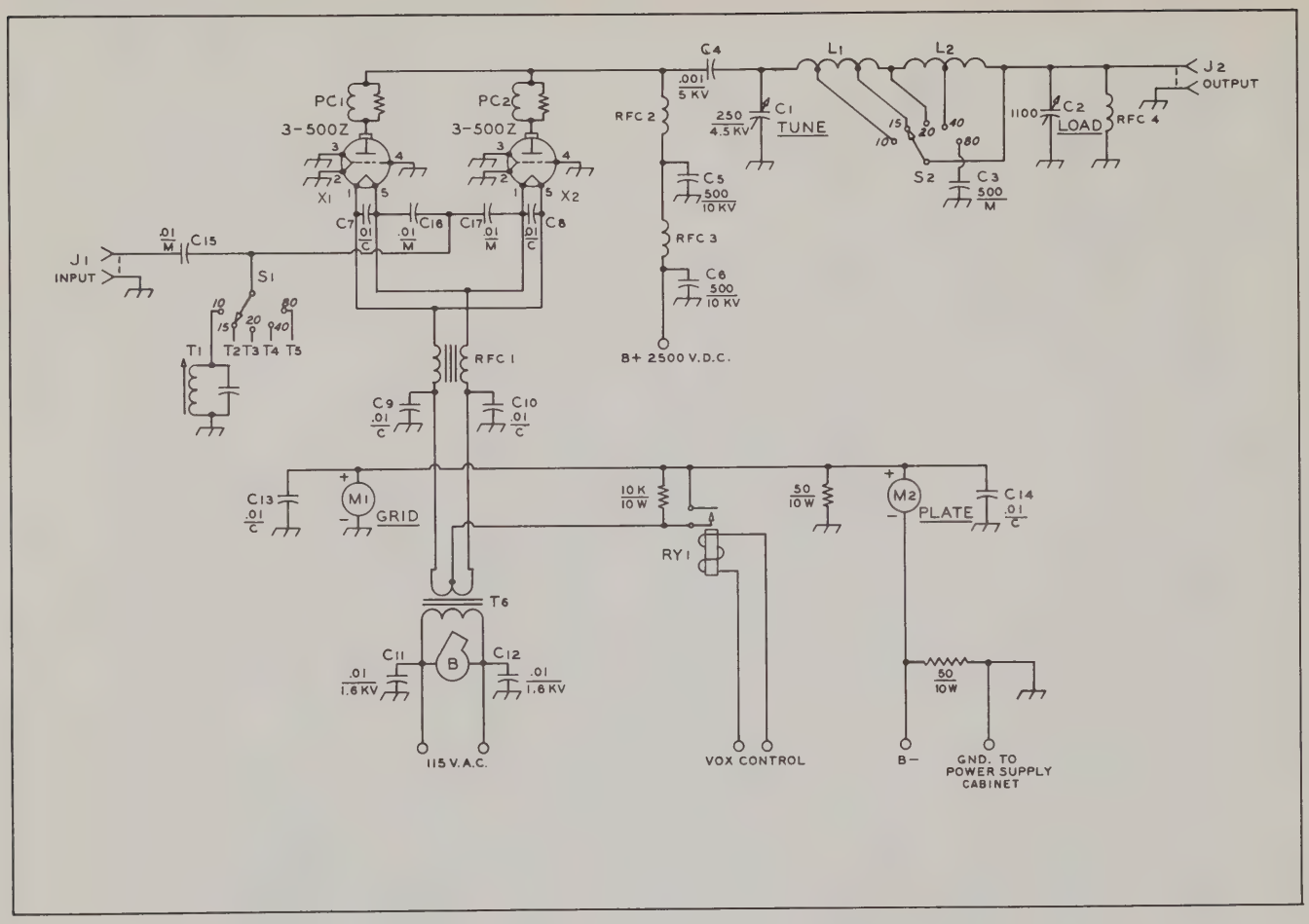
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. METRIC EQUIVALENTS TO THE NEAREST .01mm, ARE GIVEN FOR GENERAL INFO ONLY & ARE BASED ON 1 INCH=25.4mm.
3. BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THK. WITH HOLE DIAS. OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMS. (K) B (M)






EIMAC 3–500Z
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
600
500
400
300
200
100
.05
.03
.01
2.2
1.8
1.4
1.0
.80
.60
.40
.10
.001
150
125
100
75
50
25
0
–25
GRID VOLTAGE – (V)
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE – (V)
#4265


EIMAC 3–500Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
.400
.300
.200
1.6
1.4
1.2
1.0
.80
.60
.40
.20
.100
.001
.100
.050
–125
–100
–75
–50
–25
0
25
50
0
1000
2000
3000
4000
5000
FILAMENT TO GRID VOLTAGE – (V)
PLATE TO GRID VOLTAGE – (V)
#4264



TYPICAL CATHODE DRIVEN (GROUNDED GRID) AMPLIFIER CIRCUIT FOR TWO 3-500Z TUBES

C-1--250 pF, 4.5 kV (Johnson 154-16).

C-2--1100 pF, 3 section. Jackson Bros. LE-3-4595-380. (M. Swedgal, 258 Broadway, N.Y. 10007).

C-3-500 pF, 2.5 kV mica. Sangamo H-5347.

C-4--.001 μF, 5kV. Centralab 858S-1000.

C-5, C-6--500 pF, 10 kV, TV "door knob" capacitor.

C-7 thru C-10--.01 μF, 600V ceramic capacitor (Centralab DD-103).

C-11, C-12--.01 μF, 1.6 kV ceramic capacitor (Centralab DD16-103).

C-13, C-14--.01 μF, 600V ceramic capacitor (Centralab DD-103).

C-15 thru C-17--.01 μF, 1 kV mica capacitor (Sangamo H-2210).

M-1--500 mAdc.

M-2--1000 mAdc.

RFC-1--50 μH. 14 bifilar turns #10 AWG enamelled wire wound on ferrite core, Q-1 material, 5 inches long, ½ inch diameter. (Permag Central Corp., 1213 Estes Avenue, Elk Grove Village, IL 60007; Catalog #S-206-Q1). Notch core with file and break to length.

RFC-2-100 μH, 1 Adc. 112 turns #26 AWG, spacewound wire diameter on 1" diam., 6" long ceramic from (Centralab X-3022H insulator). Series resonant with terminals shorted to 24.5 MHz.

RFC-3--20 ohm, 50 watt wirewound resistor used as choke.

RY-1--VOX operated SPST relay. Energized when transmit.

PC-1, PC—2--Three 100 ohm, 2W carbon resistors in parallel. Three turns #14 AWG, ½" diam., ¾" long in parallel with resistors. (Equivalent: Ohmite P-300 reduced to 3 turns).

J-1, J-2--Coaxial receptacle. UG-58A/U, for type N connector.

T-6--5 V at 30 amp. Chicago-Stancor P-4648.

X-1, X-2--EIMAC SK-410 socket and EIMAC SK-406 chimney.

B-Blower--13 cubic feet at 0.2 inch back pressure. Use #3 impeller at 3100 rpm. (Ripley 8472, Dayton 1C-180 or Redmond AK-2H-01AX).

CATHODE CIRCUIT COMPONENTS:

T-1 (10 meters)--0.15 μH. 4 turns #14 AWG on ½-inch form, ½-long. Parallel capacitance: 200 pF, 1 kV silver mica capacitor. Resonant at 28.7 MHz.

T-2 (15 meters)--0.15 μH, same as T-1. Resonant at 21.3 MHz with 470 pF, 1 kV silver mica capacitor.

T-3 (20 meters)--0.31 μH. 6 turns #14 AWG on ½-inch form, ½-inch long, slug tuned (National XR-50). Resonant at 14.2 MHz with 470 pF, 1 kV silver mica capacitor.

T-4 (40 meters)--0.31 μH, same as T-3. Resonant at 7.2 MHz with 940 pF. (Two 470 pF 1 kV silver mica capacitors in parallel).

T-5 (80 meters)--1.3 μH. 13 turns #18 AWG on ½-inch diameter form, ½-inch long, slug turned (National XR-50). Resonant at 3.8 MHz with 940 pF, same as T-4.

PLATE CIRCUIT COMPONENTS (for plate potential of 2500 Vdc), R_L=1725 Ω:

The 10, 15 and 20 meter inductor (L_1) may be 10½ turns #8 AWG copper wire (or 3/16" tubing) 2" diam., 3" long. Ten meter tap is 5¼ turns from plate end; 15 meter tap is 7¼ turns from plate end. The 40-80 meter coil (L_2) may be 16 turns #10 AWG, 2½" diam., 4" long. 40 meter tap is 8 turns from junction with coil L-1.

S-2--Single pole ceramic switch, high voltage 30° index. Radio Switch Corp. Model 86-A.

NOTE: For additional data on plate circuit design, write for Amateur Service Bulletin #30, "Pi and Pi-L Networks for Linear Amplifier Service".

NOTE: B- of power supply is floating and grounded only through plate meter M_2 and the 50 ohm safety resistor. Cabinet of power supply should be grounded to amplifier cabinet as safety measure.

TECHNICAL DATA

8161
3CX2500A3
8251
3CX2500F3
3CX2500H3
MEDIUM-MU
POWER TRIODES

The EIMAC 3CX2500A3, 3CX2500F3, and 3CX2500H3 are medium-mu, all ceramic-and-metal, forced-air cooled, external anode power triodes with a maximum plate dissipation rating of 4000 watts. High power output as an amplifier, oscillator, or modulator may be obtained at moderate voltages.

The 3CX2500A3 has a rugged, low-inductance cylindrical filament-stem structure, which readily becomes a part of a linear filament tank circuit for VHF operation. The grid provides good shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals.

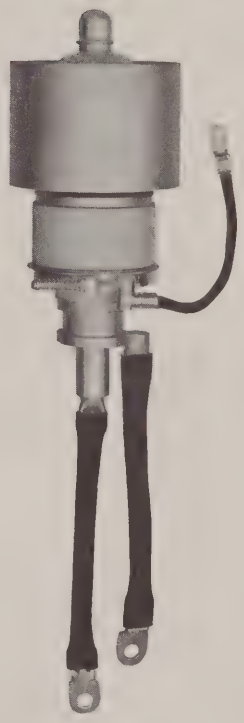
The 3CX2500F3 tube is identical except for the addition of flexible leads on the base for grid and filament connections which can simplify socketing in low frequency applications.

The 3CX2500H3 tube also has flexible leads for the filament connections, but the grid terminates on a rugged flange, which may be used for mounting the tube in industrial applications, and the ceramic is glazed for ease of cleaning.

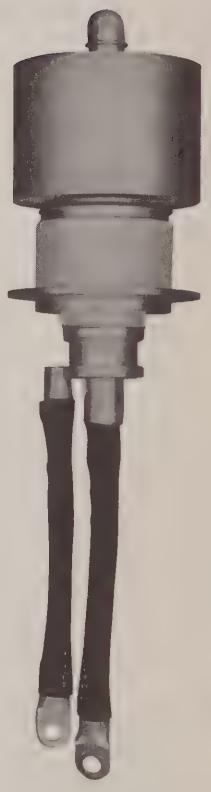
3CX2500A3



3CX2500F3



3CX2500H3



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten		
Voltage	7.5	0.37 V
Current @ 7.5 V		51.5 A
Amplification Factor (average)		22
Direct Interelectrode Capacitance (grounded filament)[2]		
Cin		35 pF
Cout		0.9 pF
Cgp		20 pF
Frequency of Maximum Rating: (3CX2500A3)		110 MHz
Frequency of Maximum Rating: (3CX2500F3/H3)		75 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture.

4088 (Effective 3-1-79) © 1979 by Varian

Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:

Length (3CX2500A3)	9.000 In; 22.76 cm
(3CX2500F3/H3, incl. fil. leads	18.437 In; 46.83 cm
Diameter (3CX2500A3/F3)	4.156 In; 10.56 cm
(3CX2500H3)	4.250 In; 10.79 cm
Operating Position (all 3 types)	Vertical, base up or down
Net Weight (Approx): (3CX2500A3)	6.2 lb; 2.8 kg
(3CX2500F3)	7.0 lb; 3.2 kg
(3CX2500H3)	6.5 lb; 2.9 kg
Cooling	Forced Air
Base (3CX2500A3)	Special Coaxial
(3CX2500A3/H3)	Special with Flying Leads
Maximum Operating Temperature:	
Anode Core & Ceramic/Metal Seals	250°C
3CX2500F3/H3 Filament Lead/Tube Base Junctions	150°C

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier, Class-C FM or Telegraphy (Key-down Condtions)

MAXIMUM RATINGS

DC PLATE VOLTAGE - 6000 VOLTS
DC PLATE CURRENT - 2.5 AMPERES
PLATE DISSIPATION - 4000 WATTS
GRID DISSIPATION - 150 WATTS
DC GRID VOLTAGE - -1000 VOLTS
DC GRID CURRENT - 0.4 AMPERE

TYPICAL OPERATION (Frequencies below 30 MHz)

Plate Voltage	4000	5000	6000	Vdc
Plate Current	2.5	2.5	2.08	Adc
Grid Voltage	—300	—450	—500	Vdc
Grid Current	245	265	180	mAdc
Peak RF Grid Input Voltage*	580	750	765	v
Driving Power*	142	197	136	W
Grid Dissipation*	68	78	46	W
Plate Input Power	10,000	12,500	12,500	W
Plate Dissipation	2500	2500	2500	W
Plate Output Power	7500	10,000	10,000	W

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier, Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE - 5500 VOLTS
DC PLATE CURRENT - 2.0 AMPERES
PLATE DISSIPATION - 2670 WATTS
GRID DISSIPATION - 150 WATTS
DC GRID VOLTAGE - -1000 VOLTS

TYPICAL OPERATION (Frequencies below 30 MHz)

Plate Voltage	4000	4500	5000	Vdc
Plate Current	1.67	1.47	1.25	Adc
Grid Voltage	—450	—500	—550	Vdc
Grid Current*	180	140	150	mAdc
Peak RF Grid Input Voltage*	685	715	760	v
Driving Power*	125	100	115	W
Grid Dissipation*	43	30	32	W
Plate Input Power	6670	6615	6250	W
Plate Dissipation	1670	1315	950	W
Plate Output Power	5000	5300	5300	W

*Approximate values.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE - 6000 VOLTS
DC PLATE CURRENT - 2.5 AMPERES
PLATE DISSIPATION - 4000 WATTS
GRID DISSIPATION - 150 WATTS
DC GRID VOLTAGE - -1000 VOLTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

Plate Voltage	4000	5000	6000	Vdc
Grid Voltage[1]	—150	—190	—240	Vdc
Zero-Signal DC Plate Current	0.6	0.5	0.4	Adc
Max-Signal DC Plate Current	4.0	3.2	3.0	Adc
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390	v
Max-Signal Peak Driving Power*	340	230	225	w
Max-Signal Nominal Driving Power*	170	115	113	W
Max-Signal Plate Output Power	11,000	11,000	13,000	W

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	MIN.	MIN.	
Filament: Current at 7.5 volts	48	54	A
Interelectrode Capacitance[1] (grounded filament connection)			
Input	29.2	40.2	pF
Output	0.6	1.2	pF
Feedback	16.8	23.2	pF
Grid Bias voltage, for anode voltage = 3000 Vdc and anode current = 0.83 Adc	-67	-100	Vdc

1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

MECHANICAL

MOUNTING - Any of the three tubes must be mounted vertically, base up or down at the convenience of the circuit designer. The 3CX2500H3 is normally mounted by its grid flange.

Filament connection to the base of the 3CX2500A3 is normally made by spring collets. These are available from EIMAC with the following part numbers:

149575 Inner Line Collet
149576 Outer Line Collet

Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - The maximum temperature rating for the anode core and the ceramic/metal seal areas of these tubes is 250° C, and sufficient forced-air cooling must be provided to assure operation at safe tube temperatures. Tube life is usually prolonged if cooling in excess of absolute minimum requirements is provided for cooler tube temperatures.

The filament leads of the F3 and H3 versions are attached to the tube with soft solder, and care must therefore be taken to supply sufficient cooling to this area of the tube to maintain temperatures below 150° C to avoid melting or loosening of these leads.

Minimum air flow requirements to maintain anode core and ceramic/metal seal areas below 225° C at sea level with an inlet-air temperature of 40° C are tabulated for air-flow in the base-to-anode and anode-to-base directions. At higher ambient temperatures, frequencies above 30 MHz, or at higher altitudes, a greater quantity of air will be required.

Base-to-Anode Air Flow				
	Sea Level		5,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop Inches water	Air Flow CFM	Pressure Drop Inches water
2500	36	0.60	43	0.72
4000	67	1.20	80	1.45
Anode-to-Base Air Flow				
2500	42	0.70	50	0.84
4000	84	1.70	101	2.00

With air flowing in a base-to-anode direction, and with the specified air also flowing past the base section of the tube, no additional base cooling of these types is normally required. With air flowing in an anode-to-base direction, they will require additional cooling air directed into the filament stem structure, between the inner and outer filament terminals, in

the amount of 5 cfm minimum, directed by an appropriate air nozzle or pipe.

It is suggested that temperatures, especially in the base area of the tube, be monitored in any new installation to insure proper cooling. Temperatures may be measured with any of the available temperature-sensing paint or crayon materials.

ELECTRICAL

FILAMENT OPERATION - The filament voltage, as measured at the filament terminals, should be 7.5 volts, with maximum allowable variations due to line fluctuations of from 7.12 to 7.87 volts.

INTERLOCKS - An interlock device should be provided to insure that cooling air flow is established before application of electrical power, including the filament. The circuit should be so arranged that rf drive cannot be applied in the absence of normal plate voltage.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as these, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

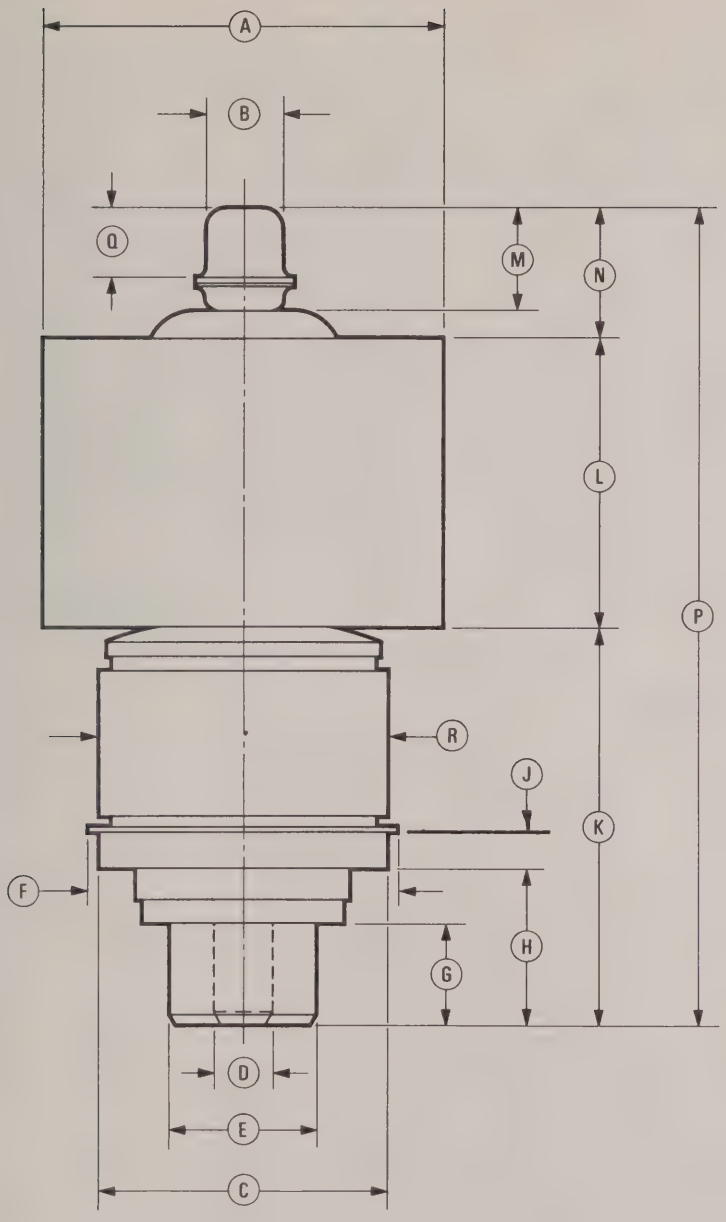
FAULT PROTECTION - In addition to normal cooling airflow interlock and plate overcurrent interlock it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high plate voltage. In all cases some protective resistance should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. EIMAC Application Bulletin #17 titled "FAULT PROTECTION" is available on request and contains considerable detail on the subject.

HIGH VOLTAGE - Normal operating voltages used with these tubes are deadly; and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

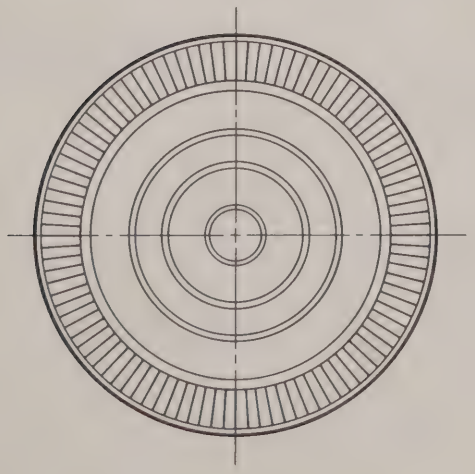
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division. EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN	MAX.	REF	MIN	MAX.	REF
A	4.094	4.156	- -	103.99	105.56	- -
B	0.781	0.844	- -	19.83	21.44	- -
C	2.990	3.010	- -	75.95	76.45	- -
D	0.615	0.635	- -	15.62	16.13	- -
E	1.490	1.510	- -	37.85	38.35	- -
F	- -	3.625	- -	- -	92.08	- -
G	0.813	0.937	- -	20.65	23.80	- -
H	1.375	1.625	- -	34.92	41.28	- -
J	0.391	0.422	- -	9.93	10.72	- -
K	3.875	4.250	- -	98.43	107.95	- -
L	2.937	3.063	- -	74.60	77.80	- -
N	1.187	1.687	- -	30.15	42.85	- -
P	8.000	9.000	- -	203.20	228.60	- -
Q	0.687	0.813	- -	17.45	20.65	- -

NOTES
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

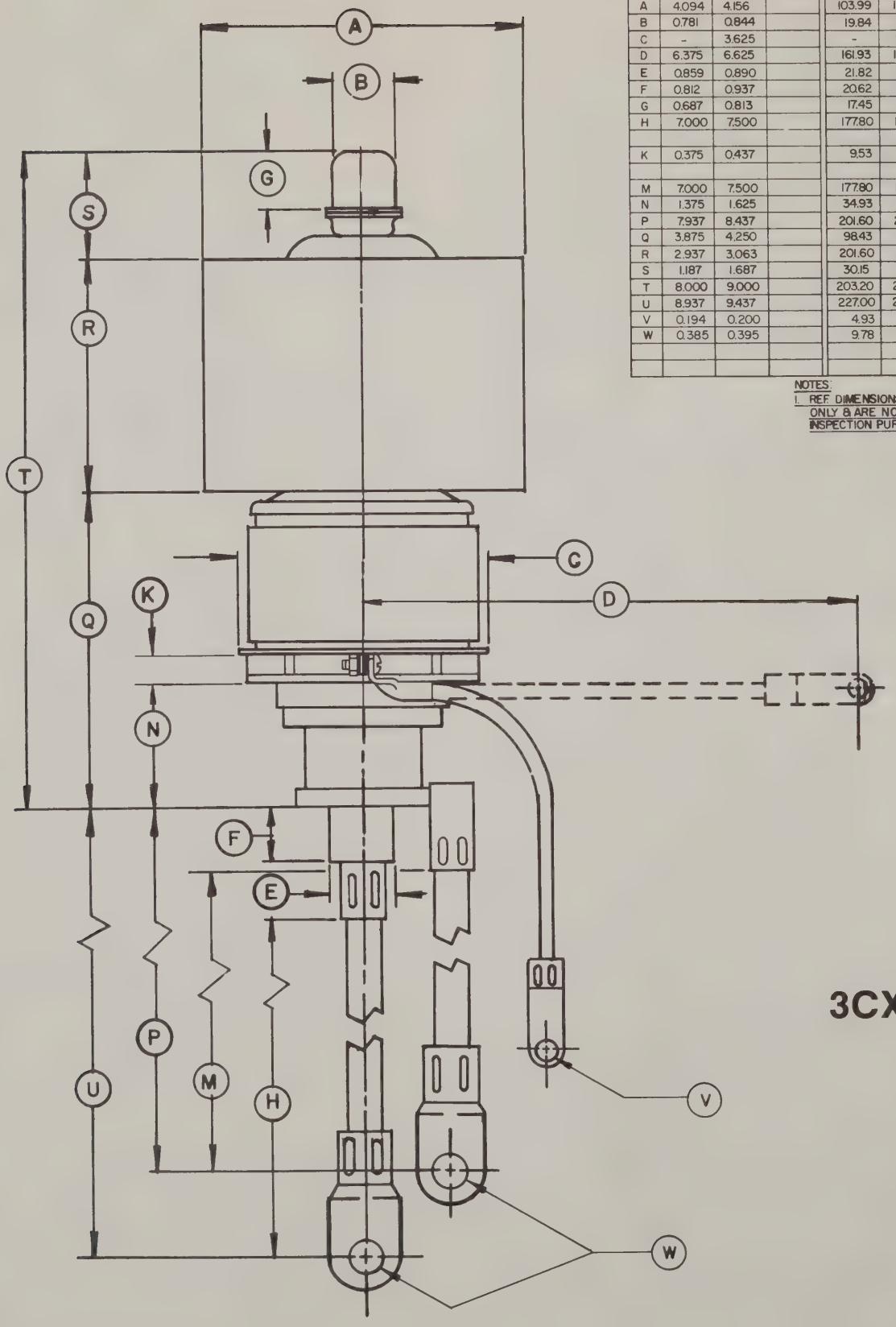


3CX2500A3

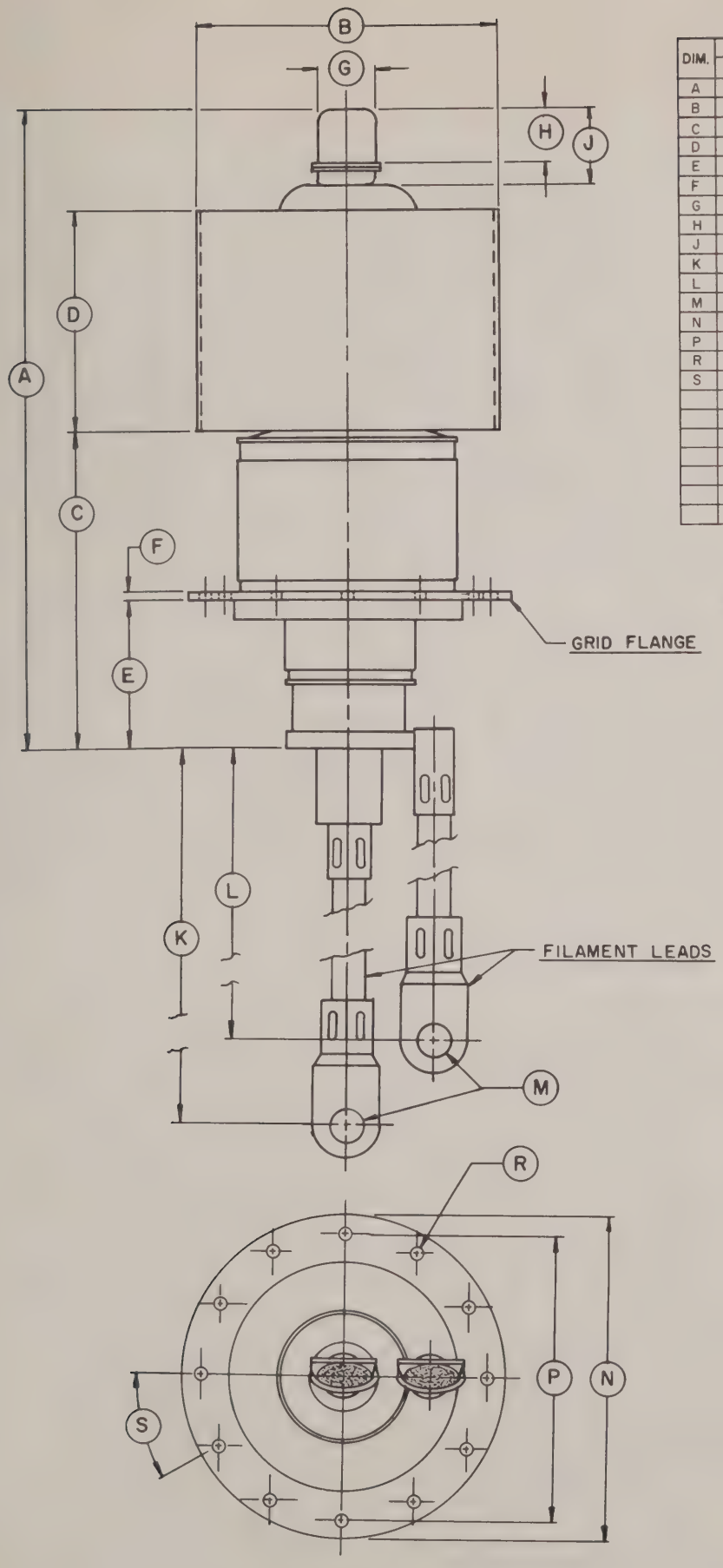
DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX	REF	MIN.	MAX.	REF
A	4.094	4.156		103.99	105.56	
B	0.781	0.844		19.84	21.44	
C	-	3.625		-	92.08	
D	6.375	6.625		161.93	168.28	
E	0.859	0.890		21.82	22.61	
F	0.812	0.937		20.62	23.80	
G	0.687	0.813		17.45	20.65	
H	7.000	7.500		177.80	190.50	
K	0.375	0.437		9.53	11.10	
M	7.000	7.500		177.80	190.50	
N	1.375	1.625		34.93	41.28	
P	7.937	8.437		201.60	214.30	
Q	3.875	4.250		98.43	107.95	
R	2.937	3.063		201.60	214.30	
S	1.187	1.687		30.15	42.85	
T	8.000	9.000		203.20	228.60	
U	8.937	9.437		227.00	239.70	
V	0.194	0.200		4.93	5.08	
W	0.385	0.395		9.78	10.03	

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



3CX2500F3



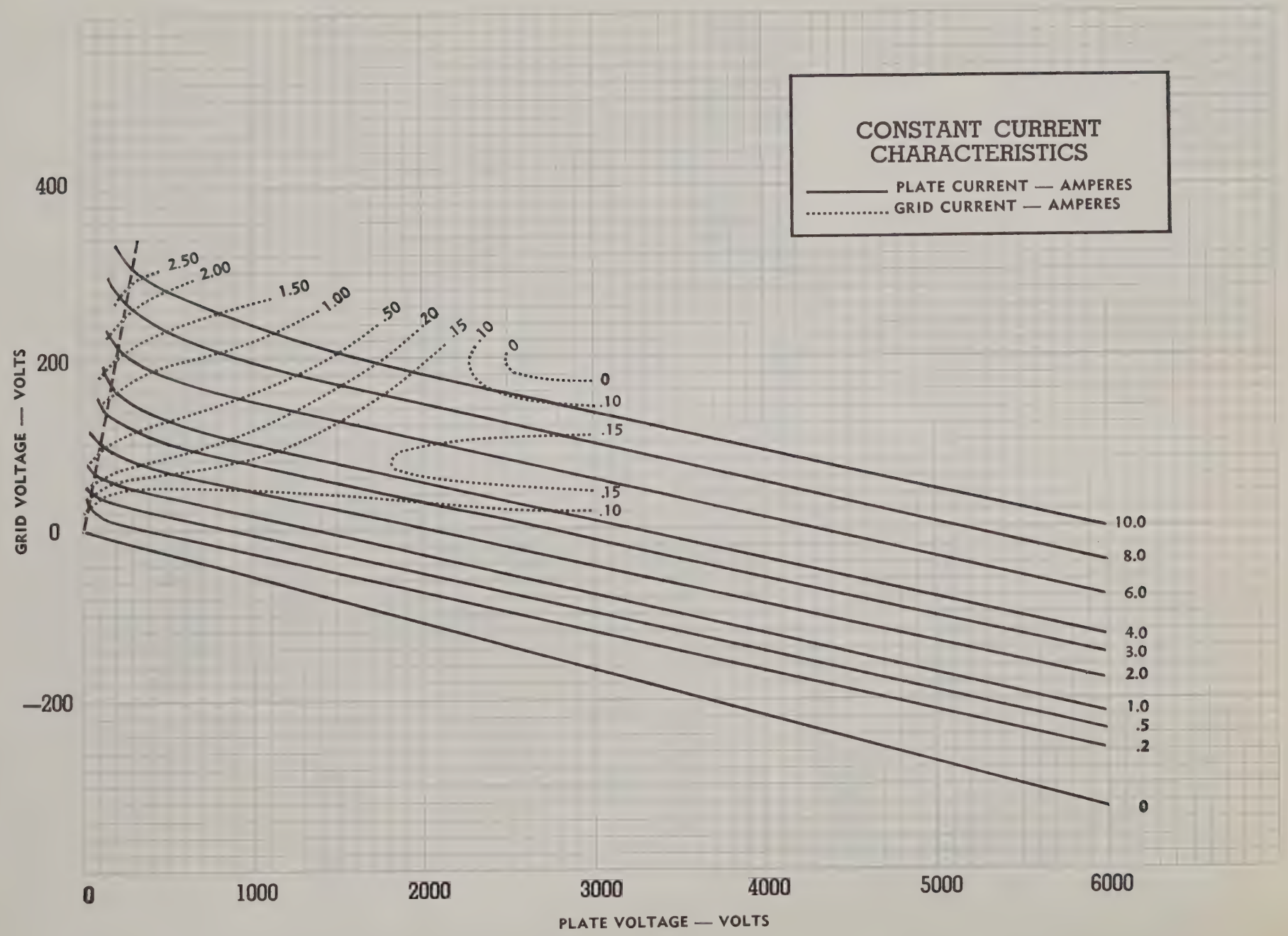
DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF	MIN.	MAX.	REF
A	8.000	9.000	- -	203.20	228.60	- -
B	4.093	4.156	- -	103.96	105.56	- -
C	3.875	4.250	- -	98.43	107.95	- -
D	2.937	3.062	- -	74.60	77.77	- -
E	1.703	1.953	- -	43.26	49.61	- -
F	- -	- -	0.125	- -	- -	3.18
G	0.781	0.843	- -	19.84	21.41	- -
H	0.687	0.812	- -	17.45	20.62	- -
J	1.000	1.125	- -	25.40	28.58	- -
K	8.937	9.437	- -	227.00	239.70	- -
L	7.937	8.437	- -	201.60	214.30	- -
M	- -	- -	0.390	- -	- -	9.91
N	4.230	4.250	- -	107.44	107.95	- -
P	3.855	3.885	- -	97.92	98.68	- -
R	- -	- -	0.250	- -	- -	6.35
S	29°	31°	- -	29°	31°	- -

NOTES:

1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. THERE ARE 12 HOLES IN GRID FLANGE.
3. GRID FLANGE AND FILAMENT LEADS ARE TO BE ORIENTED AS SHOWN

3CX2500H3


CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
400
200
0
—200
GRID VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0

TECHNICAL DATA

8809 / 4CX600J
8921 / 4CX600JA
ULTRA LINEAR POWER TETRODE

The EIMAC 8809/4CX600J is a ceramic/metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 600 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 8809/4CX600J especially suitable for radio-frequency and audio-frequency linear amplifier service.



The 8921/4CX600JA has a larger anode cooler for reduced cooling air pressure-drop. It is electrically identical to the 4CX600J.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage	6.0 ± .3 V
Current, at 6.0 volts	5.4 A
Cathode-Heater Potential (maximum)	±150 V
Transconductance (Average):	
I_b = 0.3 Adc, E_{c2} = 350 Vdc	27,000 μmhos
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	50.0 pF
Cout	6.3 pF
Cgp	0.13 pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:

	4CX600J	4CX600JA
Length	2.71 in; 68.8 mm	2.71 in; 68.8 mm
Diameter	2.08 in; 52.8 mm	2.52 in; 64.0 mm
Net Weight	7.7 oz; 218 gm	9.0 oz; 255 gm
Operating Position	Any	
Maximum Operating Temperature:		
Ceramic/Metal Seals	250°C	
Anode Core	250°C	

(Effective 8-1-78) © 1978, 1971 by Varian Printed in U.S.A.

Cooling	Forced air
Base	JEDEC B8-236
Recommended Air System Socket	SK-607
Recommended Air Chimney (4CX600J)	SK-646
Recommended Air Chimney (4CX600JA)	SK-656

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	450	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	1	WATT

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum outout power and are referenced against one tone of a two equal tone signal.
3. Approximate values.
4. Cathode resistor 11 ohms, bypassed by 4000 pF.
5. Cathode resistor 11 ohms, no bypass capacitor.
6. Complex signal such that dc plate current maximum rating of 600 mA not exceeded.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB, Grid Driven, Peak Envelope or Modulation Crest Conditions.

Plate Voltage	2000	2000	2500	Vdc
See Notes	---	(4)	(5&6)	
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-41	-48	-50	Vdc
Zero-Signal Plate Current	300	200	175	mAdc
Single-Tone Plate Current	500	497	680	mAdc
Two-Tone Plate Current	350	365	475	mAdc
Single-Tone Screen Current 3	5	16	30	mAdc
Two-Tone Screen Current 3	-2	3	10	mAdc
Single-Tone Grid Current 3	0	0	0.5	mAdc
Two-Tone Grid Current 3	0	0	0.2	mAdc
Peak rf Grid to Ground Voltage 3.	32	39.5	70	v
Single-Tone Useful Output Power	550	553	1100	W
Resonant Load Impedance	2000	2000	2000	Ω
Intermodulation Distortion Products 2				
3rd Order	-43	-46	-40	db
5th Order	-43	-51	-40	db

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	450	VOLTS
DC PLATE CURRENT	.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	1	WATT

TYPICAL OPERATION (Two Tubes) Class AB1

Plate Voltage	2000	2500	2800	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1/3	-52	-52	-52	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max. Signal Plate Current	1.13	1.14	1.14	Adc
Zero-Signal Screen Current	-1	-2	0	mAdc
Max. Signal Screen Current	52	48	52	mAdc
Peak af Grid Voltage 2	46	46	46	v
Plate Output Power	1430	1720	1985	W
Load Resistance(plate to plate)	3850	4200	4800	Ω

1. Approximate value.
2. Per Tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	5.0	5.8	A
Cathode Warmup Time	5	--	minutes

Interelectrode Capacitances[1] (grounded cathode connection)	Min.	Max.
Cin	46.0	54.0 pF
Cout	5.7	7.0 pF
Cgp	---	0.2 pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

COOLING - The maximum temperature rating for the anode core and the metal/ceramic seals of these tubes is 250° C. Sufficient forced-air cooling must be provided to maintain operating trmperatures within this rating. Air flow requirements to maintain tube temperatures at 225° C with a cooling air inlet temperature of 50° C are tabulated below, for operation below 30 MHz, for the tube mounted in the recommended air-system socket and chimney, in the special mounting plate shown on the outline drawing, with air flowing in the base-to-anode direction. Pressure drop will be higher if the socket is not mounted in the special mounting plate.

Since the power dissipated by the heater represents about 33 watts and since grid plus screen dissipation can represent additional power, allowance has been made in preparing this tabulation for an additional 40 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown below plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling.

Plate Dissipation Watts	4CX600J			
	Sea Level		10,000 FEET	
	Air Flow CFM	Press.Drop in. water	Air Flow CFM	Press.Drop in. water
450	10	0.33	14.6	0.47
600	14	0.58	20.5	0.85
	4CX600JA			
450	6	0.08	8.8	0.12
600	11	0.15	16	0.22

HEATER - The rated heater voltage for these tubes is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value except for short periods.

It is recommended that the heater voltage be applied for a period of not less than 5 minutes before other operating voltages are applied.

Refer to EIMAC Division of Varian for special instructions if it is necessary to reduce cathode warmup time.

GRID OPERATION - The grid dissipation rating of these tubes is 1 watt. The design features which make these such extremely linear tubes also contribute to very low grid interception. The grid may be driven into the positive grid region in the typical operation of the tube.

SCREEN OPERATION - Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on the individual tube. The 4CX600J and 4CX600JA, under some operating conditions, may indicate negative screen currents in the order of 10 milliamperes.

The maximum rated power dissipation for the screen grid is 15 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a zener regulator may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series regulator is employed. The screen bleeder current

should approximate 20 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

PLATE OPERATION - The maximum rated plate dissipation power is 600 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency loses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

INTERMODULATION DISTORTION - The typical radio frequency linear amplifier operating conditions, including the distortion data, are based on actual operation in a grid-driven amplifier. Because the 4CX600J and 4CX600JA have very low grid interception it is possible to drive the grid positive with minimum adverse effects upon the distortion level or upon the driver. Class AB2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX600J or 4CX600JA be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.

In general, linearity is improved as grid bias value is shifted toward Class A operation. Linearity may also be improved without sacrifice of efficiency by use of cathode resistors bypassed for rf, or with no bypass capacitor. See "Radio Frequency Linear Amplifier, Typical Operation".

FAULT PROTECTION - These tubes operate at voltages which can cause severe damage in the event of an internal arc, unless the tube is properly protected. This damage may be relatively minor in tubes operating from low energy power supplies, but will become catastrophic in those cases where large amounts of stored energy or follow-on current are involved. Some means of protection is advised in all cases but is mandatory in those instances where destructive quantities of energy are involved. In addition to protecting the tube in the event of a tube or circuit malfunction, these protective measures can also protect associated circuitry.

The addition of a series resistor in the anode and/or screen grid line will limit peak currents and provide a means of dissipating the energy in the event of a tube or circuit arc. This resistance should be as high as can practically be used without dissipating an excessive amount of power. Typically, a resistance of 20 to 50 ohms is sufficient to protect the tube structure in the event of an arc. It will also serve as protection to the other circuit components, such as bypass capacitors, rf chokes, meters,and diodes. A maximum of 4 joules total energy should be permitted to be dumped into an internal arc. Any amount in excess of 4 joules will permanently damage either the oxide cathode or the fine wire grid structure. In a typical case involving a 2000 Vdc power supply with a 2 μfd filter capacitor a total of 4 joules is stored in the capacitor alone, not including the energy resulting from follow-on current from the power supply.

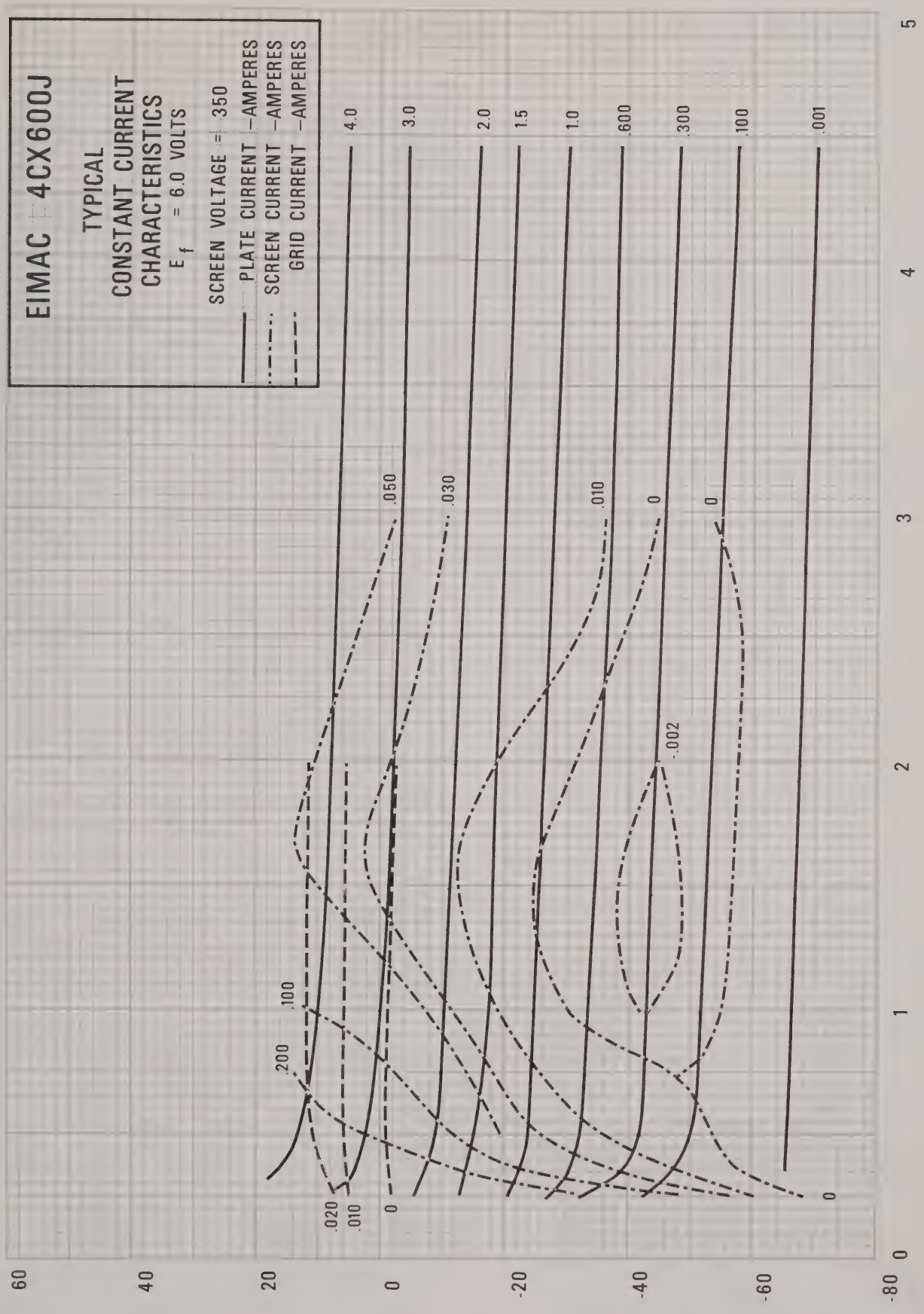
EIMAC Application Bulletin #17 titled "FAULT PROTECTION" is available on request, and includes additional information, including recommendations for those cases where tubes are operated in parallel, or in distributed amplifiers, where stored power supply energy is very high, and suggests a test procedure to determine if the protective circuitry being employed is adequate.

CAUTION-HIGH VOLTAGE – Operating voltage for the 4CX600J and 4CX600JA can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

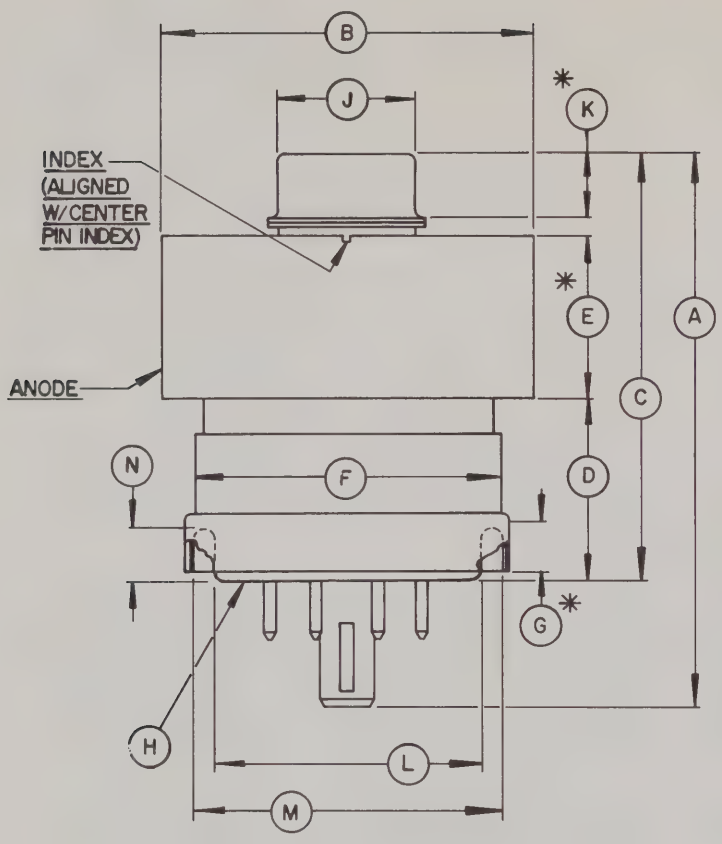
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

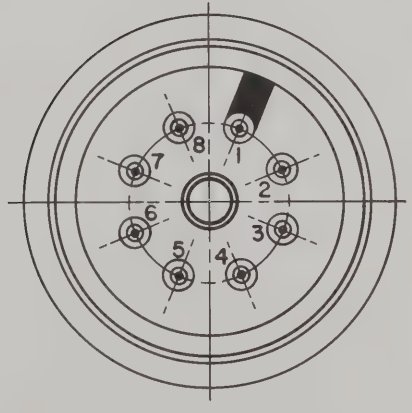
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


EIMAC 4CX600J
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 350
PLATE CURRENT –AMPERES
SCREEN CURRENT –AMPERES
GRID CURRENT –AMPERES
4.0
3.0
2.0
1.5
1.0
.600
.300
.100
.001
.050
.030
.010
0
.002
.200
.100
.020
.010
0
0
0
60
40
20
0
-20
-40
-60
-80
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)

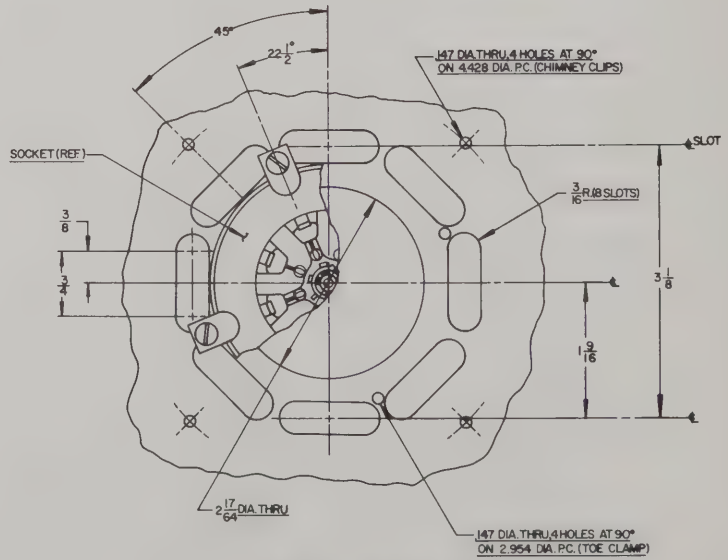
CURVE #3836



8809/4CX600J DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.507	2.707	63.68	68.76
B	2.050	2.080	52.07	52.83
C	1.973	2.173	50.11	55.19
D	0.910	1.030	23.11	26.16
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--
L	1.175	1.190	29.85	30.23
M	1.325	1.360	33.66	34.54
N	0.205	--	5.21	--
8921/4CX600JA				
B	2.485	2.515	63.00	63.80
ALL ELSE SAME AS ABOVE				



PIN DATA
PIN 1 &/OR BASE RING-SCREEN GRID
PINS 2,4,7-CONTROL GRID
PINS 3,6,8-CATHODE
PIN 5-HEATER
CENTER PIN-HEATER



CHASSIS CUTOUT PATERN REQ'D. FOR ADEQUATE COOLING.
USE SK 646 CHIMNEY WITH THIS SOCKET.

* 8973

WATER-COOLED
POWER TETRODE

* Previous designation was X-2170

TECHNICAL DATA

The EIMAC 8973 is a ceramic/metal, water-cooled power tetrode designed for very-high-powered medium-frequency or high-frequency broadcast service and very-low-frequency communication in the half-megawatt power range.

The 8973 has a thoriated-tungsten mesh filament mounted on water-cooled supports. The maximum anode dissipation rating is 650 kilowatts steady state.

Large-diameter coaxial terminals are used for the control grid and the rf filament terminals. Filament power and filament support cooling-water connections are made through special couplings.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten Mesh		
Voltage	18.5 ± 0.9	V
Current at 18.5 V	650	A
Amplification Factor (Average), Grid to Screen	4.5	
Direct Interelectrode Capacitance (grounded cathode):[2]		
Cin	1000	pF
Cout	165	pF
Cgp	5	pF

Frequency of Operation: useful to 100 MHz.

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values shown are nominal, measured with no special shielding.

MECHANICAL

Maximum Overall Dimensions:	
Length	18.75 in; 47.62 cm
Diameter	17.03 in; 43.26 cm
Net Weight	153 lbs; 69.5 kg
Operating Position	Vertical, base down
Cooling	Water and Forced Air
Base Terminals	Special

(Effective 7-1-78) © 1978 by Varian Printed in U.S.A.

Recommended Filament Connectors (not supplied with tube):

Filament Power/Water Connector (2 required)	EIMAC SK-2310
Filament rf Connector (1 required)	EIMAC SK-2315

Recommended Anode Cooling Water Connectors (not supplied with tube):

Note: 2 SK-2320 or SK-2321 connectors are required per tube.

Complete fitting, with knurled nut, replaceable electrolytic target, 20-inch length canvas hose, corona shield, and 2-1/2-inch female pipe fitting to mate to rigid pipe	EIMAC SK-2320
Fitting similar to SK-2320 but does not include the 20-inch length of canvas hose and pipe fitting	EIMAC SK-2321

Maximum Operating Temperature:

Envelope, and Ceramic/Metal Seals	200 °C

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC PLATE CURRENT	65	AMPERES
PLATE DISSIPATION	650	KILOWATTS
SCREEN DISSIPATION	7.5	KILOWATTS
GRID DISSIPATION	2.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Peak Envelope Conditions

Plate Voltage	20.0	kVdc
Screen Voltage	1500	Vdc
Grid Voltage [1]	-360	Vdc
Zero Signal Plate Current	10	Adc
Single Tone Plate Current	45	Adc
Single Tone Screen Current [2]	2.0	Adc
Peak rf Grid Voltage [2]	360	v
Plate Dissipation	250	kW
Plate Load Resistance	264	Ω
Plate Power Output	610	kW

1. Adjust to specified zero-signal plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

(Key-down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC PLATE CURRENT	65	AMPERES
PLATE DISSIPATION	650	KILOWATTS
SCREEN DISSIPATION	7.5	KILOWATTS
GRID DISSIPATION	2.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	21.0	kVdc
Screen Voltage	2.5	Vdc
Grid Voltage	-600	Vdc
Plate Current	63	Adc
Screen Current [1]	9	Adc
Grid Current [1]	3.5	Adc
Calculated Driving Power	3.5	kW
Plate Dissipation [1]	273	kW
Plate Load Resistance	166	Ω
Plate Power Output	1050	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	17.5 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC PLATE CURRENT	50 AMPERES
PLATE DISSIPATION	400 KILOWATTS
SCREEN DISSIPATION	7.5 KILOWATTS
GRID DISSIPATION	2.0 KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	17.5 kVdc
Screen Voltage	800 Vdc
Grid Voltage	-800 Vdc
Plate Current	50 Adc
Screen Current [1]	4 Adc
Grid Current [1]	2.2 Adc
Pk. Screen Voltage (100% Mod)	800 v
Pk. rf Grid Voltage	1060 v
Calculated Driving Power	2400 W
Plate Dissipation	175 kW
Plate Load Resistance	165 Ω
Plate Output Power	700 kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB

ABSOLUTE MAXIMUM RATINGS (per tube):

DC PLATE VOLTAGE	22.5 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC PLATE CURRENT	65 AMPERES
PLATE DISSIPATION	650 KILOWATTS
SCREEN DISSIPATION	7.5 KILOWATTS
GRID DISSIPATION	2.0 KILOWATTS

1. Adjust for stated zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION Two Tubes - Sinusoidal Wave

Plate Voltage	17.5 kVdc
Screen Voltage	1500 Vdc
Grid Voltage [1]	-400 Vdc
Zero Signal Plate Current	5 Adc
Max. Signal Plate Current	78 Adc
Max Signal Screen Current [2]	2.8 Adc
Pk. Audio Freq. Grid Voltage [3]	370 v
Max. Signal Plate Dissipation [3]	550 kW
Plate/Plate Load Resistance	444 Ω
Plate Output Power [4]	950 kW

3. Per Tube.
4. Suitable to modulate a carrier power of 1.25 Megawatts.

NOTE: TYPICAL OPERATION data are obtained by calculation from the published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power then the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

APPLICATION

MECHANICAL

MOUNTING - The 8973 must be mounted vertically, base down. The full weight of the tube should rest on the main screen-grid contact flange at the base of the tube, and all lifting of the tube should be done with the lifting eye which is attached to the top of the anode cooling jacket.

COOLING - Minimum cooling water requirements for the anode are shown in the table, for an outlet water temperature not to exceed 70° C and an inlet water temperature of 50° C. System pressure should not exceed 100 psi. High-purity water must be used to minimize power loss, corrosion of metal fittings, and loss of anode dissipation capability. Water resistivity must be maintained at 1 megohm/cm (at 25° C) or better for long-term operation. EIMAC Application Bulletin #16 should be consulted for details on maintenance of water quality standards and use of a water purification loop in the installation. Since the anode is normally at high potential to ground, water connections to the anode are made through insulating tubing, with long enough sections that column resistance is above 4 megohms per 1000 plate supply volts, or 10 megohms total, whichever is less.

Anode Dissipation (kW)	Water Flow (gpm)	Apprx. Jacket Press. Drop (psi)
250	120	20
450	165	30
650	200	40

The tube base requires air cooling, with a minimum of 50 cfm of air at 50° C maximum at sea level, directed toward the base seal areas from a general purpose fan.

Water cooling of the filament and screen grid supports is also required, with inlet water temperature not to exceed 50° C. Each of the 2 filament connectors includes both an inlet and outlet line, with the proper section for the inlet water shown on the outline drawing. Minimum flow for the F1 connector is 2.0 gpm, at an approximate pressure drop of 12 psi. Minimum flow for the F2 connector is 4.0 gpm, at an approximate pressure drop of 50 psi. The screen grid cooling water is fed by means of 1/4-18 NPT tapped holes shown on the outline drawing, with a minimum flow of 2.0 gpm required, at an approximate pressure drop of 12 psi.

All cooling must be applied before or simultaneously with the application of electrode voltages, including the filament, and should be maintained for at least two minutes after all voltages are removed to allow for tube cooldown.

As regards base air cooling, temperatures of the ceramic/metal seals and the lower envelope areas are the controlling and final limiting factor. Temperature-sensitive paints are available for use in checking temperatures in these areas before equipment design and air-cooling arrangements are finalized.

ELECTRICAL

FILAMENT OPERATION - Filament turn-on and turn-off should be programmed in accordance with a special procedure. Filament voltage should be smoothly increased from zero to the operating level over a period of two minutes, and a motor-driven VARIAC or POWERSTAT is suggested. Inrush current must never be allowed to exceed twice the normal operating current. Turnoff procedure should be a smooth decrease from the operating voltage to zero over a period of two minutes, such as would be provided by a motor-driven VARIAC, POWERSTAT or solid-state regulator circuit.

Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal voltage, variations of ±5% are tolerable and should have little effect on the electrical performance of the tube. When very long life and consistent performance are factors, the filament voltage can often be reduced to a lower value than the nominal, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable a typical procedure would involve a one-to-one regulating transformer feeding a variable-ratio transformer, which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage, and when stable operation is achieved the voltage is then reduced in small steps, until a point is reached where performance of the tube is clearly affected. The voltage is then raised a few tenths of a volt above this level for operation. Periodically the procedure should be repeated and the operating value of filament voltage readjusted if necessary. This value is normally 16.5 to 17.0 volts rms (initially).

Where hum is an important system consideration it may be necessary to operate the filaments with dc rather than ac power, or provide suitable hum-bucking circuits.

Care should be exercised to keep any rf power out of the filament of the tube, as this can cause excessive operating temperatures. A HEWLETT-PACKARD Vector Impedance meter is useful in detecting the presence of impedance that will support rf buildups in the filament "backcavity" circuit.

VACION PUMP OPERATION - The tube is supplied with an ion pump and magnet, mounted inside the filament structure at the base (stem). A power supply (Varian Part #921-0015) and 8-foot cable (Varian Part #924-0020) are required for operation.

It is reommended that the VACION pump be operated continuously if possible; otherwise it should be operated at least once a year until the indicator meter shows 1.0 μA or less of current.

ABSOLUTE MAXIMUM RATINGS - The values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation, load variation, or manufacturing variations in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

GRID OPERATION - The 8973 control grid is rated at 2000 watts of dissipation. Protective measures should be included in the circuitry to insure that this rating is not exceeded. Control grid

dissipation is the approximate product of the dc grid current and peak positive grid voltage.

SCREEN GRID OPERATION - Base cooling (air and water) must be on and at the correct level before tube operation is started. The power applied to the screen grid must not exceed 7500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of rms screen current and rms screen voltage.

Plate voltage, plate load, or grid bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective circuitry must be provided to remove screen power in case of such a fault condition. Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design and operating conditions. The screen supply voltage must be maintained constant for any values of negative or positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished by use of a shunt regulator circuit in the screen voltage supply, bleeder resistors, or other suitable techniques.

PLATE OPERATION - The maximum dissipation rating of the 8973 is 650 kilowatts with water cooling. When used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 400 kilowatts.

Specified anode dissipation ratings assume 10 kilovolts maximum anode voltage during conduction. If full rated dissipation at a tube drop greater than this value for periods greater than 200 milliseconds is desired, contact EIMAC's Power Grid Tube Application Engineering Office.

FAULT PROTECTION - To assure nondestruction of tube elements from high-energy power supplies, during a fault condition, all supplies must be checked for proper operation of their protective circuits. An approved method to meet the tube protection criteria would be the use of foil, solder wire, or small diameter wire to produce a controlled short on the power supply. The simplest technique is to short the plate to cathode, screen grid to cathode, control grid to cathode, and screen grid to anode (individually, one at a time) using a vacuum relay through a section of #30 AWG copper wire, which should be approximately inches long. The wire will remain intact if the power supply protective circuitry is operating properly. An electronic crowbar will be required on the anode supply, and may be required on the other electrode supplies if the test outlined above is not passed. See EIMAC Application Bulletin #17 for further details.

Properly rated spark gaps should be located between the screen grid and cathode, and between the control grid and cathode, to meet over-voltage protection criteria. A series resistance of 10 to 50 ohms is recommended in the screen and control grid power supply leads.

HIGH VOLTAGE - Normal operating voltages used with the 8973 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

LOAD VSWR - The load VSWR should be monitored and the detected signal used to operate the interlock system to remove the plate voltage within 20 milliseconds after a fault occurs. In the case of high stored energy in the load system, care must be taken to avoid excessive return energy from damaging the tube and associated circuit components.

X-RADIATION - High-vacuum tubes operating at voltages in excess of 15 kilovolts produce progressively more dangerous X-Radiation as the voltage is increased. The 8973, operating at its rated voltages and currents, is a potential X-Ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-Radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-Ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-Radiation level should be made, and the tube should never be operated without adequate shielding in place when voltages above 15 kilovolts are in use. Lead glass, which attenuates X-Radiation, is available for viewing windows. If there is any doubt as to the requirements for or the adequacy of shielding, an expert in this field should be contacted to perform an X-Radiation survey of

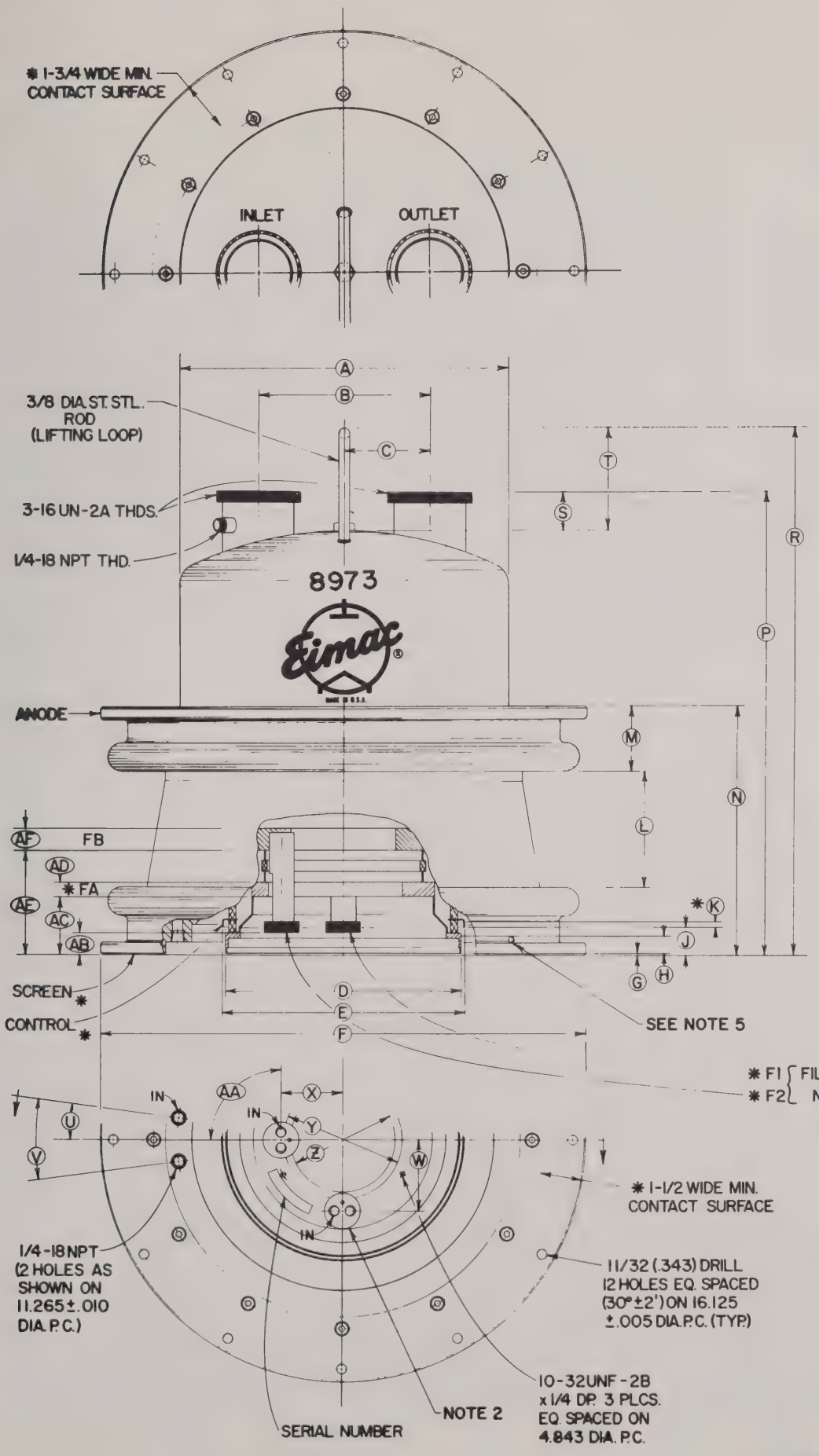
the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-Radiation exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

ELECTRODE RF TUNING CHARACTERISTICS - Typical electrode tuning characteristics may be obtained by contacting the EIMAC Power Grid Tube Application Engineering Office.

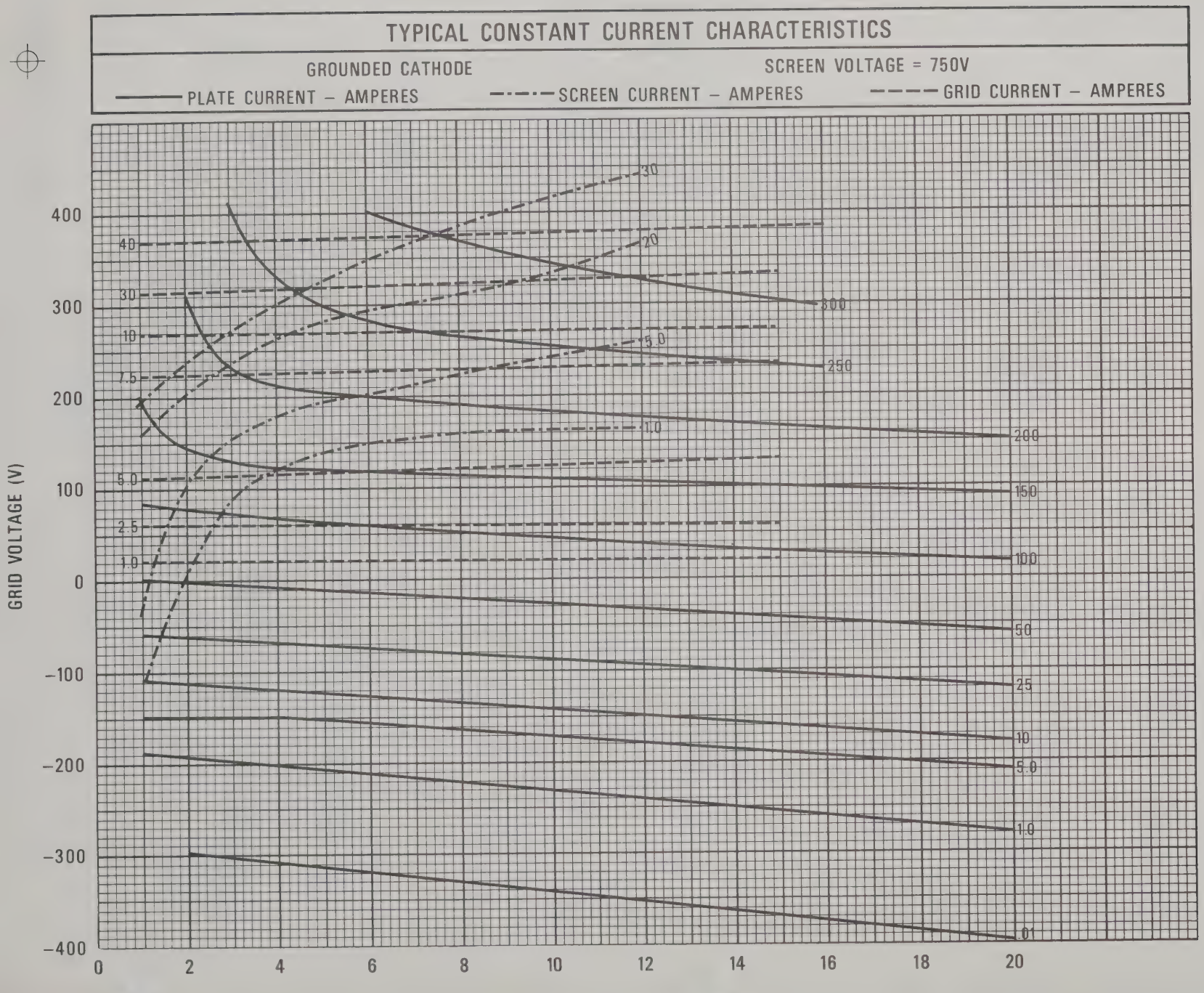
SPECIAL APPLICATIONS - Where it is desired to operate this tube under conditions widely different from those listed here, write to: Product Line Manager, High Power Tubes, Varian EIMAC Division, 301 Industrial Way, San Carlos, CA 94070.



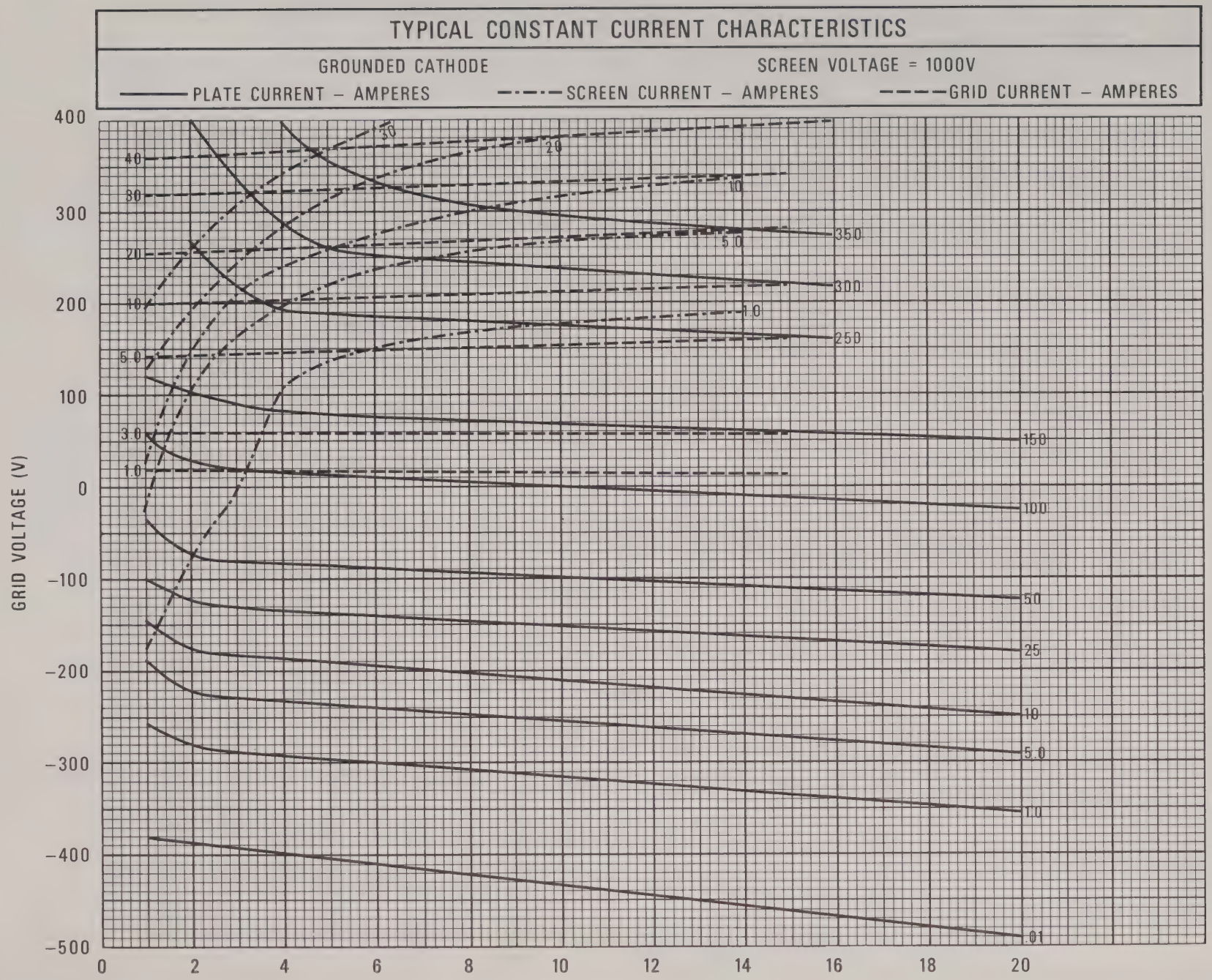
DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	11.440	11.560	- -	290.6	293.6	- -
B	- -	- -	6.000	- -	- -	152.4
C			3.000			76.2
D	8.235	8.265	- -	209.2	209.9	- -
E	8.485	8.525	- -	215.5	216.5	- -
F	16.970	17.030	- -	431.0	432.6	- -
G	- -	- -	0.025	- -	- -	0.63
H	0.310		- -	7.9	- -	- -
J	0.900	1.000	- -	22.9	25.4	- -
K	0.180	- -	- -	4.6	- -	- -
L	- -	- -	4.093	- -	- -	104.0
M	- -	- -	2.375	- -	- -	60.3
N	8.700	8.900	- -	221.0	226.0	- -
P	16.250	16.500	- -	412.7	419.1	- -
R	18.500	18.750	- -	469.9	476.2	- -
S	- -	- -	1.375	- -	- -	34.9
T	- -	- -	3.575	- -	- -	90.8
U	- -	- -	7-1/2°	- -	- -	7-1/2°
V	- -	- -	15°	- -	- -	15°
W	- -	- -	2.500	- -	- -	63.5
X	- -	- -	2.156	- -	- -	54.8
Y	4.113	4.137	- -	104.5	105.1	- -
Z	3.675	3.699	- -	93.3	93.9	- -
AA	- -	- -	90°	- -	- -	90°
AB	- -	- -	0.720	- -	- -	18.3
AC	1.950	2.100	- -	49.5	53.3	- -
AD	0.450	- -	- -	11.4	- -	- -
AE	3.560	3.680	- -	90.4	93.5	- -
AF	0.725	- -	- -	18.4	- -	- -

NOTES:

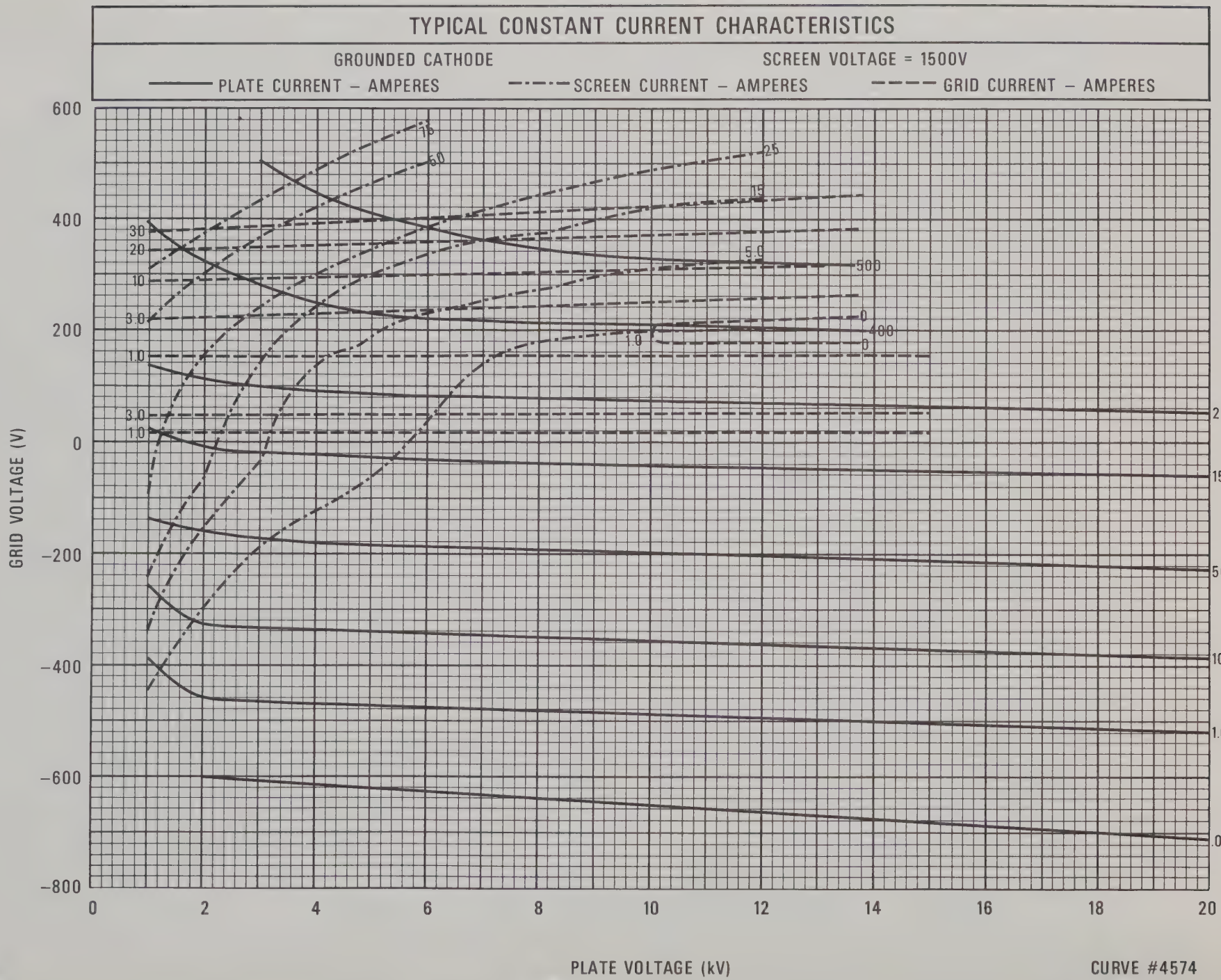
1. CIRCUIT RETURN MAY BE MADE TO FA BY SK-2315 CONNECTOR.
2. MATE WITH EIMAC CONNECTOR SK-2310 (2 Reqd.).
3. REF. DIMENSIONS ARE FOR INFO. ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
4. (*) CONTACT SURFACES.
5. 1/4 DIA. WATER DRAIN HOLES - 3 PLACES.

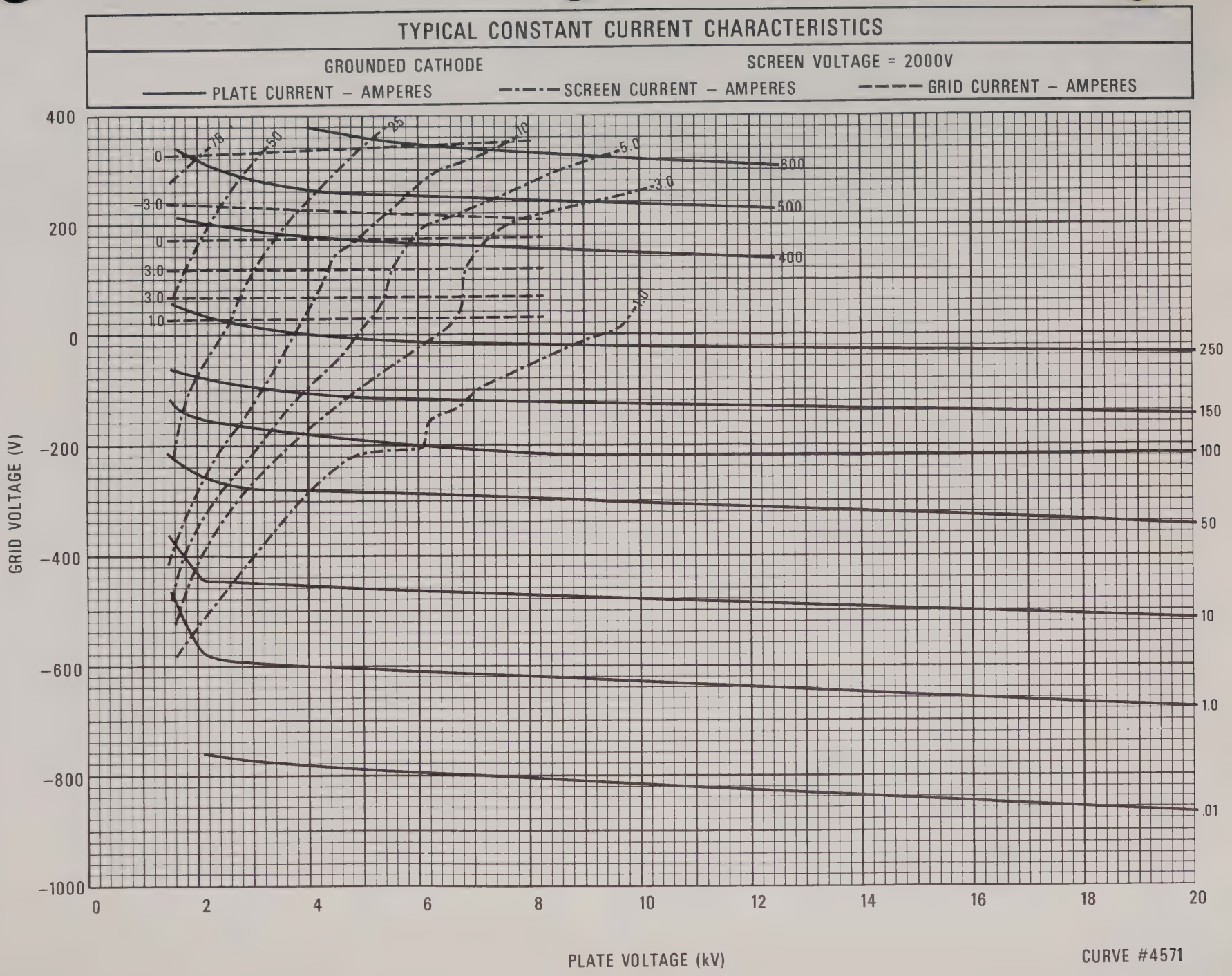

TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 750V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
400
300
200
100
0
–100
–200
–300
–400
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (
30
40
20
30
10
5.0
7.5
1.0
5.0
2.5
1.0
300
250
200
150
100
50
25
10
5.0
1.0
01

CURVE #4575


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 1000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
400
300
200
100
0
−100
−200
−300
−400
−500
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
40
30
20
10
5.0
3.0
1.0
350
300
250
150
100
50
25
10
5.0
1.0
.01

CURVE #4573


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
600
400
200
0
–200
–400
–600
–800
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
75
60
25
15
30
20
10
5.0
500
3.0
0
400
1.0
0
1.0
3.0
1.0
250
150
50
10
1.0
.01
CURVE #4574


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 2000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
400
200
0
–200
–400
–600
–800
–1000
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
CURVE #4571
600
500
400
250
150
100
50
10
1.0
.01
75
50
25
10
5.0
3.0
1.0
0
3.0
0
3.0
3.0
1.0

TECHNICAL DATA

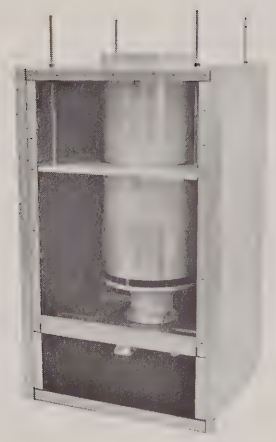
VHF CAVITY

CV-2200

FOR FM BROADCAST SERVICE

The EIMAC CV-2200 is a power-amplifier cavity assembly designed for use as the final amplifier in the 88-108 MHz band assigned for FM broadcast service.

Cavity design is straightforward and relatively simple. The amplifier tube used is the EIMAC 8989 or 8990, both of which are high-performance tetrodes designed especially for VHF applications. In this cavity assembly the tube in use is grid-driven for a stage gain of approximately 19 dB with a useful power output of 20 kW with the 8989, or approximately 18 dB gain with a useful power output of 30 kW with the 8990.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

TUNING RANGE	88-108 MHz

MECHANICAL

Tube Type Used (not supplied with cavity)	EIMAC 8989 or 8990
Input Connector	Type N
Output Connector	3-1/8 inch EIA Coaxial
Cooling Required	Forced Air
Mounting	Optional: Designed to Fit 19 In. Rack

Overall Dimensions (nominal):

Height	36 In; 91.4 cm
Width	19 In; 48.3 cm
Depth	21 In; 53.3 cm
Net Weight (Approximate; tube not installed)	60 Lb; 27.3 kg

1. Characteristics and operating values are based on performance tests. These figures may change without notice as a result of additional data or product refinement. EIMAC should be consulted before using this information for final equipment design.

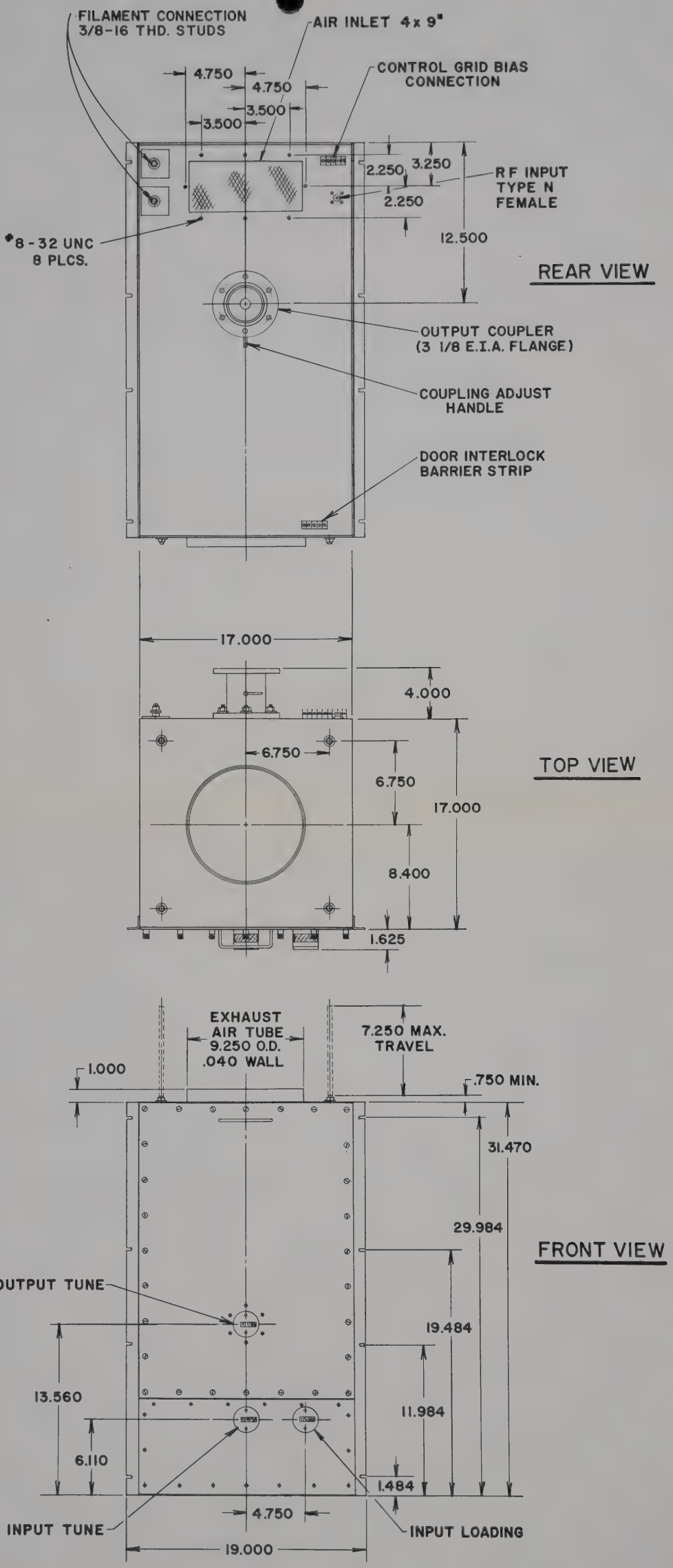
4094 (Effective 3-1-79) © by Varian

Printed in U.S.A.

TYPICAL OPERATION (95.7 MHz):

	TUBE 8989		TUBE 8990		
Heater Voltage	7.5	7.5	10.0	10.0	Vac
Heater Current (Approx.)	120	120	140	140	Aac
Anode Voltage	8.0	10.0	10.0	10.0	kVdc
Grid Bias Voltage	-300	-300	-300	-300	Vdc
Screen Grid Voltage	600	600	800	800	Vdc
Anode Current	2.40	2.45	3.20	3.95	Adc
Grid Current[1]	35	45	10	22	mAdc
Screen Current[1]	150	170	225	220	mAdc
Driving Power[1]	185	215	375	480	W
Useful Output Power[1,2]	15	20	25	30	kW
Power Gain[1]	19.0	19.6	18.2	18.0	dB
Efficiency	78	81	78	76	%
Bandwidth (3 dB points)	3	3	3	3	MHz

1. Approximate value
2. Power delivered to the load


FILAMENT CONNECTION
3/8-16 THD. STUDS
AIR INLET 4 x 9"
CONTROL GRID BIAS
CONNECTION
4.750
4.750
3.500
3.500
2.250
3.250
2.250
R F INPUT
TYPE N
FEMALE
12.500
*8-32 UNC
8 PLCS.
REAR VIEW
OUTPUT COUPLER
(3 1/8 E.I.A. FLANGE)
COUPLING ADJUST
HANDLE
DOOR INTERLOCK
BARRIER STRIP
17.000
4.000
6.750
6.750
17.000
8.400
1.625
TOP VIEW
EXHAUST
AIR TUBE
9.250 O.D.
.040 WALL
7.250 MAX.
TRAVEL
1.000
.750 MIN.
31.470
29.984
FRONT VIEW
OUTPUT TUNE
19.484
13.560
11.984
6.110
1.484
4.750
INPUT TUNE
INPUT LOADING
19.000

CV-2200

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

1-15-75

(Effective 1-15-75) © 1975 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 5-1-74
Index 5-1-74
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 5-1-74
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 5-1-74
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 11-15-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 8-15-74
3-500Z 11-1-73
3-1000Z/8164 8-15-74
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 1-11-74
3CW5000F3/8243 . . . . . see 3CW5000A3
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW20,000H7 5-15-74
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX400U7/8961 8-1-74
3CX1000A7/8283 11-1-68
3CX1500A7/8877 8-1-73
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7480	11-1-68
8873/8874/8875	6-3-73
8938	5-15-73

TETRODES

4-65A/8165	5-1-62
4-125A/4D21	6-1-67
4-250A/5D22	5-5-70
4-400A/8438	7-20-70
4-400C/6775	4-1-71
4-500A	3-10-72
4-1000A/8166	10-30-66
4CN15A	6-1-68
4CPX250K/8590	4-1-70
4CS250R	9-1-70
4CV8000A	3-15-71
4CV20,000A	6-1-68
4CV35,000A	5-15-66
4CV50,000E	5-1-70
4CV50,000J	7-15-71
4CV100,000C/8351	2-1-68
4CV250,000A	3-1-72
4CW800B/F	11-1-73
4CW2000A/8244	6-15-71
4CW10,000A/8661	4-15-63
4CW25,000A	2-1-72
4CW50,000E	7-1-70
4CW50,000J	7-15-71
4CW100,000D	7-1-67
4CW100,000E	9-1-70
4CW250,000A	3-1-71
4CX125C/F	6-1-67
4CX250B/7203 & 4CX250FG/8621	8-1-74
4CX250BC/8957	1-1-74
4CX250K/8245 & 4CX250M/8246	5-1-68
4CX250R/7580W	6-16-61
4CX300A/8167	8-30-66
4CX300Y/8561	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX350FJ/8904	9-1-71
4CX600B & 4CX600F	3-20-70
4CX600J/8809 & 4CX600JA/8921	8-15-71
4CX1000A/8168	5-1-70
4CX1000K/8352	8-20-66
4CX1500A	12-1-71
4CX1500B/8660	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	4-15-71
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	12-1-70
4W300B/8249	11-1-73
4X150A/7034 & 7609	8-1-74
4X150G/8172	10-15-73
4X500A	1-1-64
6816,6884,7843	11-15-71
7609	see 4X150A/7034
8560A	7-15-71
8876	6-15-71
8930	12-1-73
8954	6-1-74
8959	11-1-74
X2159	7-1-73

PENTODES

5-125B/4E27A	8-15-52
5-500A	5-1-68
5CX1500A	6-6-70
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

PULSE MODULATORS

4PR60C/8252W	6-30-71
4PR65A/8187	2-15-63
4PR125A/8247	3-15-64
4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6	4-4-70
Preformed Contact Finger Stock	6-15-71
HR Heat Dissipating Connectors	12-1-65
SK-300A	4-15-69
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73
SK-410	12-1-73
SK-500	3-15-67
SK-506, SK-516	4-15-69
SK-510	6-15-71
SK-600A, SK-610A	6-15-71
SK-606, SK-626, SK-636B, SK-646	11-1-74
SK-607	8-15-71

(Cont'd)

OTHER PRODUCTS

SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A, SK-712A	3-15-71
SK-740	8-15-66
SK-760, SK-770	7-27-70
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-860, SK-870	3-15-67
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210	8-15-72

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

1-15-75

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000F3/8243	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW20,000H7	T
3CW30,000H3	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX400U7	T
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203 & 4CX250FG/8621	TET
4CX250BC/8957	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4X150A/7034 see 7609	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7609 see 4X150A/7034	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
8954	TET
8959	TET
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-646 see SK-606	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
X-2150	TET
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
CROSS-REFERENCE LIST

JANUARY 15, 1975

(Revised 1-15-75) © 1973 Varian Associates Printed in U.S.A.

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC to JEDEC

EIMAC No.	JEDEC No.
2-01C	—
2-25A	—
2-50A	—
2-150D	—
2-240A	—
2-2000A	—
2C39A	2C39A
2C39WA	2C39WA
2X1000A	—
2X3000F	—
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	—
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CPX1500A7	—
3CV1500A7	—
3CV30,000A1	—
3CV30,000A3	—
3CV30,000H3	—
3CV50,000A7	—
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	—
3CW10,000A3	—
3CW10,000H3	—
3CW20,000A1	—
3CW20,000A3	—
3CW20,000A7	—
3CW20,000H3	—
3CW20,000H7	—
3CW30,000H3	—
3CW30,000H7	—
3CW40,000H3	—
3CX100A5	7289
3CX100F5	8250
3CX400U7	8961
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	—
3CX3000A1	8238
3CX3000A7	—
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	—
3CX5000H3	—
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	—
3CX15,000A3	—
3CX15,000A7	—
3CX15,000H3	—
3CX20,000A3	—
3CX20,000A7	—
3CX20,000H3	—
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	—
4-1000A	8166
4CN15A	—
4CPX250K	8590
4CS250R	—
4CV1500B	—
4CV8000A	—
4CV20,000A	—
4CV35,000A	—
4CV50,000E	—
4CV50,000J	—
4CV100,000C	8351
4CV250,000A	—
4CW800B	—
4CW800F	—
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	—
4CW50,000E	—
4CW50,000J	—
4CW100,000D	—
4CW100,000E	—
4CW250,000A	—
4CX125C	—
4CX125F	—
4CX250B	7203
4CX250BC	8957
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	—
4CX600F	—
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	—
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	—
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	—
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150G	8172
4X500A	—
5-125B	4E27A
5-500A	—
5CX1500A	—
5CX3000A	—
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	—
177A	—
177WA	6549W
250R	—
250TH	250TH
250TL	250TL
253	253
254W	—
264	8576
279	—
284	—
290	—
294	—
304TH	304TH
304TL	304TL
322	—
450TH	450TH
450TL	450TL
750TL	750TL
826	826
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8295A	8295A
8403	8403
8432	8432
8533W	8533W
8560A	8560A
8560AS	8560AS
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8892	8892
8893	8893
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8911	8911
8912	8912
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8959	8959
8960	8960
8962	8962
8963	8963
8964	8964
8965	8965

JEDEC/EIMAC CROSS-REFERENCE LIST

JEDEC to EIMAC

JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
592	3-200A3
750TL	750TL
826	826
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549W	177WA
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	4-400C
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533W	8533W
8560A	8560A
8560AS	8560AS
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912
8921	4CX600JA
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8957	4CX250BC
8959	8959
8960	8960
8961	3CX400U7
8962	8962
8963	8963
8964	8964
8965	8965


Eimac®

varian
electron tube and device group

U.S. SALES OFFICES

Atlanta
6650 Powers Ferry Rd., NW
Suite 100
Atlanta, GA 30339
TEL: (404) 252-0045

Clearwater Branch
314 South Missouri
Suite 205
Clearwater, FL 33516
TEL: (813) 446-8513

Boston
400 Totten Pond Road
Building 1
Waltham, MA 02154
TEL: (617) 890-4560

Chicago
205 W. Touhy Avenue
Park Ridge, IL 60068
TEL: (312) 825-6686

Dallas
558 So. Central Expressway
Suite 202
P.O. Box 689
Richardson, TX 75080
TEL: (214) 235-2385

Dayton
10 Southmoor Circle
Dayton, OH 45429
TEL: (513) 298-7318

Los Angeles
2901 Wilshire Boulevard, Suite 102
Santa Monica, CA 90403
TEL: (213) 828-5588

New York
#25 Route 22
Springfield, NJ 07081
TEL: (201) 376-6600

Philadelphia
306 Fellowship Rd.
Mt. Laurel, NJ 08057
TEL: (609) 235-6800

Phoenix
7117 Third Avenue, Suite 106
Scottsdale, AZ 85251
TEL: (602) 947-5461

San Francisco
4940 El Camino Real
Los Altos, CA 94022
TEL: (415) 968-7630

Syracuse
115 Twin Oaks Drive
Syracuse, NY 13206
TEL: (315) 437-2568

Washington, D.C.
4701 Lydell Drive
Cheverly, MD 20781
TEL: (301) 773-7010

INTERNATIONAL SALES OFFICES

Australia
Varian Pty. Ltd.
82 Christie Street
St. Leonards 2065
New South Wales, Australia
TEL: 43-0673

Varian Pty. Ltd.
679 Springvale Road
North Springvale, VICT. 3171
Australia
TEL: 560-7133

Benelux
Varian Benelux B.V.
Maassluisstraat 100
P.O. Box 9158
Amsterdam, Holland
TEL: (020) 15 94 10

Brazil
Varian Industria e Comercio Ltda.
AV. DR. Cardoso deMello, 1644
04548 Sao Paulo SP, Brazil
TEL: 80-80-27

Canada
Varian Associates of Canada, Ltd.
45 River Drive
Georgetown, Ontario, Canada
TEL: (416) 457-4130

France
Varian S.A.
Quartier de Courtaboeuf
Boite Postale No. 12
91401 Orsay, France
TEL: 907-78-26

Germany
Varian GmbH
Allacher Strasse-230E
8 München 50
Germany
TEL: (089) 8126 093

Italy
Varian SpA
Via Fratelli Varian
10040 Leini (Torino)
Italy
TEL: (011) 26 80 86

Japan
Marubun Corporation
1-1, Nihombashi Odemmacho 2-Chome
Chuo-Ku, Tokyo, 103 Japan
TEL: (03) 662-8151

Scandinavia
Varian AB
Skytteholmsvagen 7D
P.O. Box 1099
17122 Solna 1, Sweden
TEL: (08) 82 00 30

Switzerland
Varian AG
Steinhauserstrasse
6300 Zug, Switzerland
TEL: (042) 23 25 75

United Kingdom and Ireland
EMI-Varian Ltd.
248 Blyth Road
Hayes,
Middlesex UB3 1HR
England
TEL: 01-573 5555

1-15-75

Printed in U.S.A.

TECHNICAL DATA

8163
3-400Z

HIGH-MU
POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	V
Current	14.1	A
Amplification Factor (Average)	200	
Interelectrode Capacitances (Average),[2] Grounded-Grid Connection:		
Cin	7.1	pF
Cout	4.1	pF
Cpk	0.1	pF
Frequency for Maximum Ratings	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-All Dimensions:	
Height	5.375 In; 136.5 mm
Diameter	3.562 In; 90.47 mm
Net Weight (approximate)	7 Oz; 198 gm

(Effective 8-15-74) © 1961, 1967, 1968, 1974 by Varian

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GROUNDED-GRID, Class B

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Single-Tone Conditions)

Plate Voltage	3000	Vdc
Zero Sig. Plate Current[1]	100	mAdc
Max. Sig. Plate Current	333	mAdc
Max. Sig. Grid Current[1]	120	mAdc
Driving Impedance	122	Ω
Resonant Load Impedance	4750	Ω
Max. Sig. Driving Power[1]	32	W
Peak Envelope Plate Output Power	655	W

TYPICAL OPERATION (Minimum Distortion Products)

Plate Voltage	2000	Vdc
Zero Sig. Plate Current[1]	62	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	148	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current[1]	87	mAdc
Driving Impedance	112	Ω
Resonant Load Impedance	2750	Ω
Max. Sig. Driving Power[1]	45	W
Peak Envelope Useful Output Power[1]	445	W
Intermodulation Distortion Products[2]	-40	dB

TYPICAL OPERATION (Minimum Distortion Products at 1 kW PEP Input)

Plate Voltage	2500	Vdc
Zero Sig. Plate Current[1]	73	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	142	mAdc
Two Tone Plate Current	274	mAdc
Two Tone Grid Current[1]	82	mAdc
Driving Impedance	114	Ω
Resonant Load Impedance	3450	Ω
Peak Envelope Useful Output Power[1]	560	W
Max. Sig. Driving Power[1]	44	W
Intermodulation Distortion Products[2]	-35	dB

TYPICAL OPERATION (Minimum Distortion Products with E_b = 1500 Vdc)

Plate Voltage	1500	Vdc
Zero Sig. Plate Current[1]	46	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	163	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current[1]	92	mAdc
Driving Impedance	109	Ω
Resonant Load Impedance	1620	Ω
Peak Envelope Useful Output Power[1]	300	W
Max. Sig. Driving Power[1]	46	W
Intermodulation Distortion Products[2]	-37	dB

1. Approximate value.

2. Approximate value; referenced against one tone of a two equal-tone signal.

AUDIO FREQUENCY AMPLIFIER OR MODULATOR
Class B

MAXIMUM RATINGS (PER TUBE):

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero Sig. Plate Current[1]	200	mAdc
Max. Sig. Plate Current	666	mAdc
Max. Sig. Grid Current[1]	240	mAdc
Driving Power[1]	26	W
Peak af Driving Voltage(per tube)[1]	88	v
Load Resistance, Plate/Plate	9500	Ω
Max. Sig. Plate Output Power[1]	1310	W

RADIO FREQUENCY AMPLIFIER OR OSCILLATOR
Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000	Vdc
Plate Current	333	mAdc
Grid Voltage	-75	Vdc
Grid Current[1]	130	mAdc
Peak rf Grid Voltage[1]	187	v
Grid Driving Power[1]	25	W
Plate Output Power[1]	730	W

RADIO FREQUENCY AMPLIFIER,[1]
Plate Modulated, Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.275 AMPERE
PLATE DISSIPATION	270 WATTS
GRID DISSIPATION	20 WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000 Vdc
Plate Current	245 mAdc
Grid Voltage	-90 Vdc
Grid Current[2]	100 mAdc
Peak rf Grid Voltage[2]	185 v
Grid Driving Power[2]	18 W
Plate Output Power[2]	550 W

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

RANGE VALUES FOR EQUIPMENT DESIGN:	Min.	Max.	
Filament Current, at 5.0 volts	13.5	14.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	80	115	mAdc
Cut-Off Voltage (E_b = 3000 Vdc, I_b = 1.0 mAdc)	---	-25	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	6.0	9.0	pF
Cout	---	0.15	pF
Cgp	3.4	4.8	pF
Interelectrode Capacitance (Grounded Grid Connection)[1]			
Cin	6.0	9.0	pF
Cout	3.4	4.8	pF
Cpk	---	0.15	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING - The 3-400Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit, and the tube should be protected from severe vibration and shock.

The EIMAC SK-410 Air-System Socket is especially recommended for mounting, as the contacting clips are made with considerable flexibility in order to avoid applying undue lateral pressure on the tube pins, to avoid the possibility of damage to the base of the tube. The tube should always be inserted or removed from the socket with a straight-in or straight-out motion, and "rocking" the tube in or out of the socket should be avoided.

If a socket other than the EIMAC SK-410 is used, it should be ascertained that the contacts are flexible enough so they do not apply any significant lateral force against the tube base pins, as installed or during insertion or removal, to avoid the possibility of catastrophic damage to the glass tube base.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an air temperature of 55°C. At higher inlet air

temperatures, higher altitudes, or at frequencies above 30 MHz,the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

FILAMENT OPERATION - The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

INTERMODULATION DISTORTION - Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

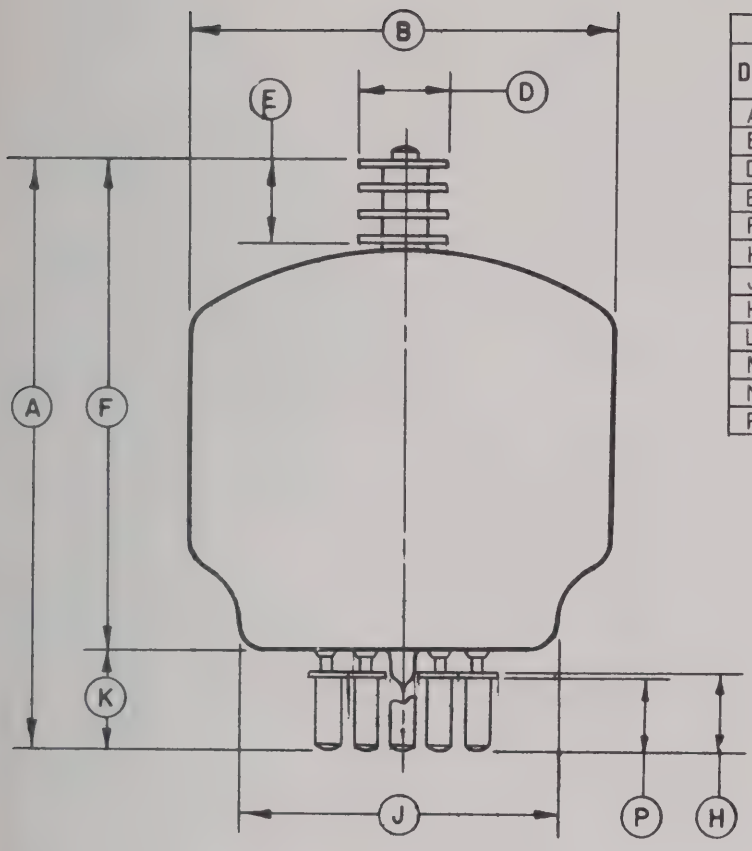
INPUT CIRCUIT - When the 3-400Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 8163/3-400Z are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

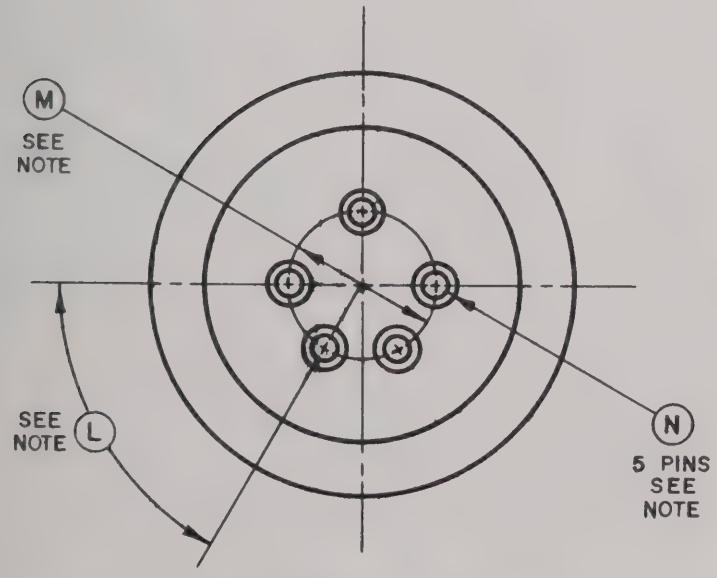


DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.875	5.375	- -	123.8	136.5	- -
B	- -	3.562	- -	- -	90.47	- -
D	0.740	0.760	- -	18.80	19.30	- -
E	0.635	0.665	- -	16.13	16.89	- -
F	3.937	4.437	- -	100.0	112.7	- -
H	0.688	0.813	- -	17.47	20.65	- -
J	- -	2.500	- -	- -	63.50	- -
K	- -	- -	0.937	- -	- -	23.80
L	- -	- -	60°	- -	- -	60°
M	- -	- -	1.250	- -	- -	31.75
N	0.185	0.191	- -	4.70	4.85	- -
P	0.625	0.750	- -	15.87	19.05	- -

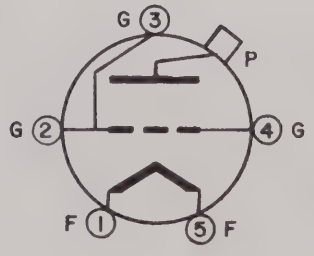
NOTES:

1. BASE PINS N ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THICK WITH HOLE DIAMETERS OF 0.204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS L & M.

2. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.



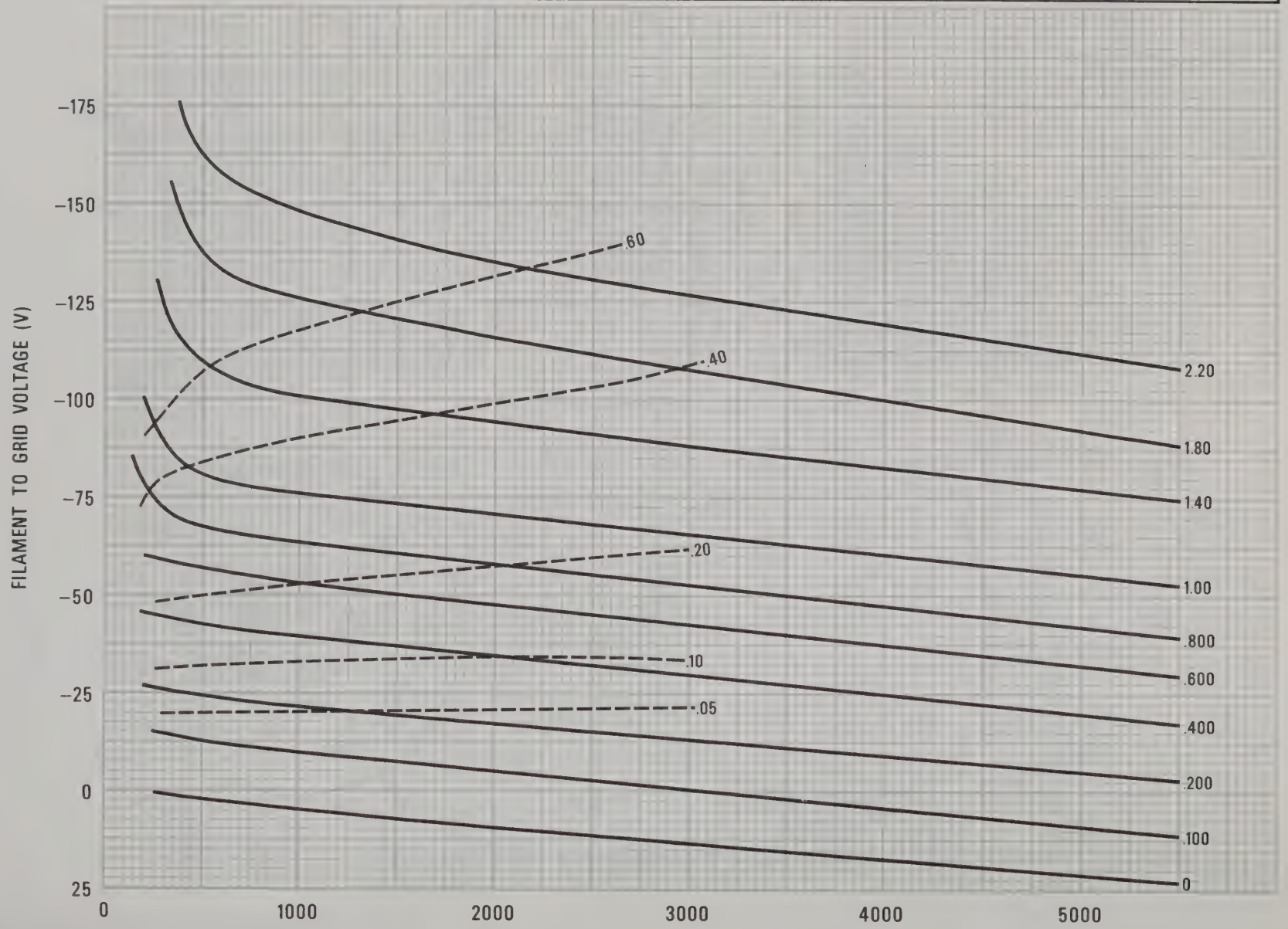
BOTTOM VIEW

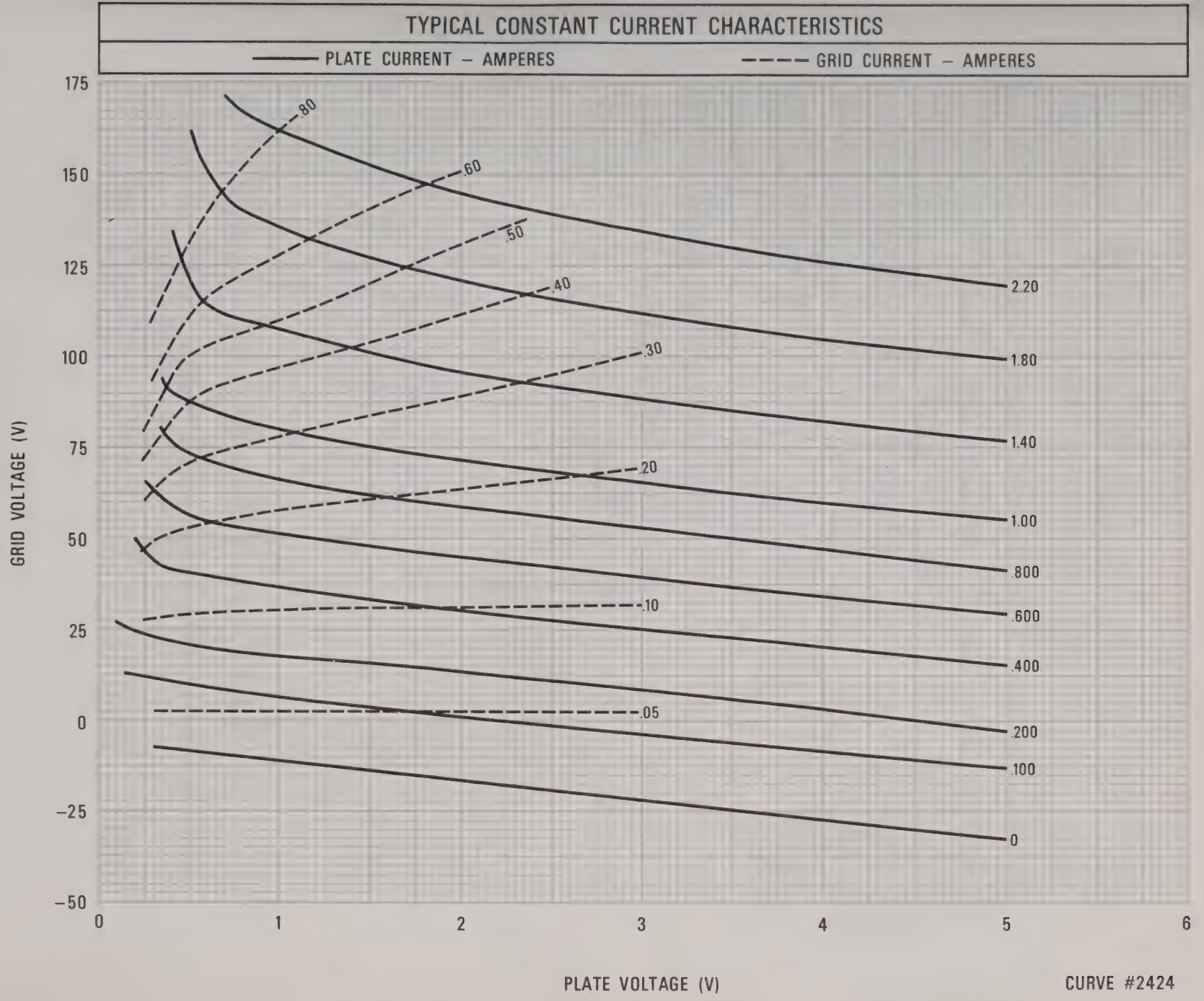


TYPICAL CONSTANT CURRENT CHARACTERISTICS

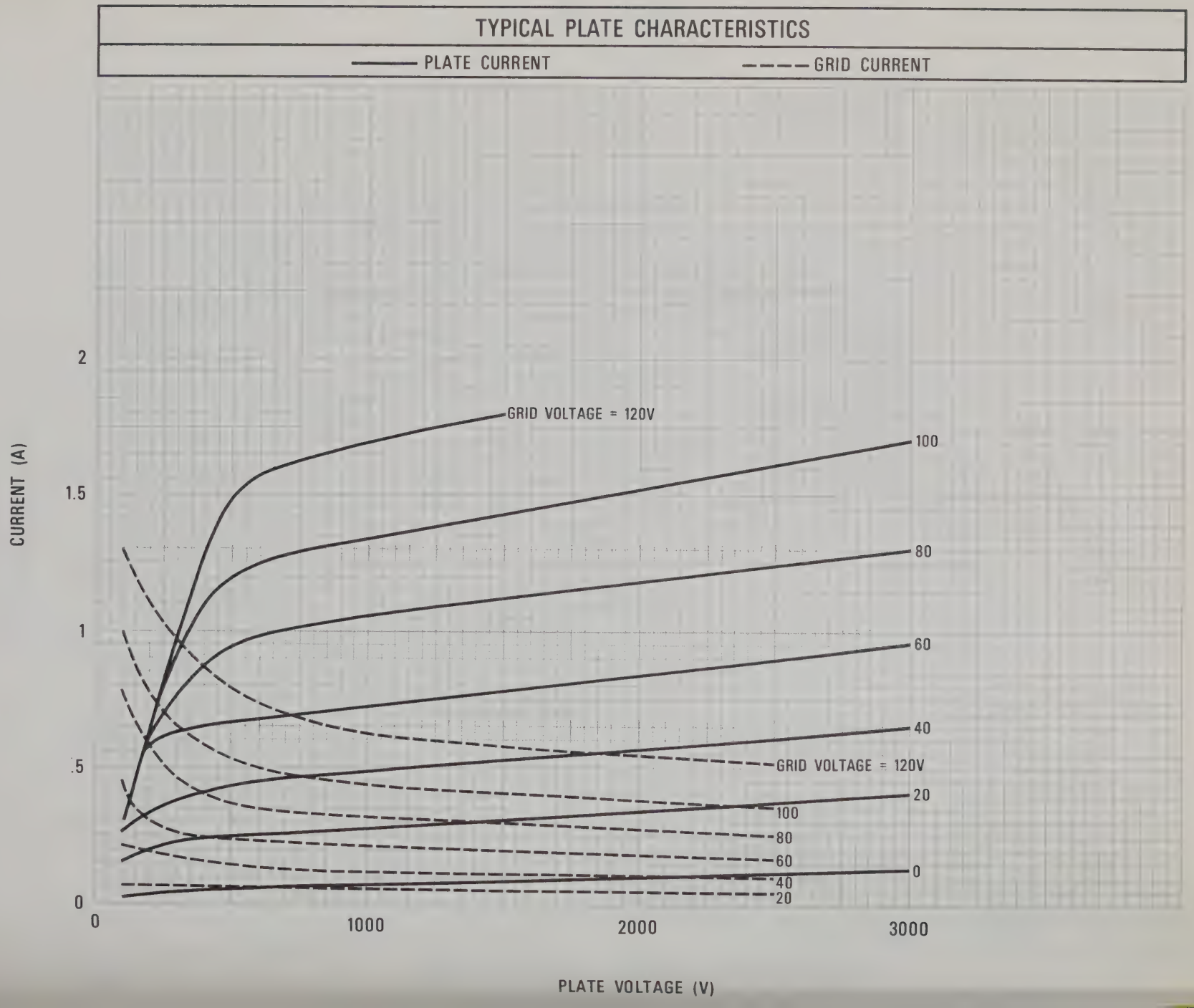
GROUNDED GRID

——— PLATE CURRENT – AMPERES - - - - GRID CURRENT – AMPERES




TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
175
150
125
100
75
50
25
0
–25
–50
0
1
2
3
4
5
6
PLATE VOLTAGE (V)
.80
.60
.50
.40
.30
.20
.10
.05
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0
CURVE #2424

TYPICAL PLATE CHARACTERISTICS



8164
3-1000Z

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 8164/3-1000Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8164/3-1000Z in a cathode driven circuit.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 ± 0.37 V
Current	20 A
Amplification Factor (Average)	200
Interelectrode Capacitance (Grounded Cathode)[2]	
Cin	17.0 pF
Cout	0.2 pF
Cgp	7.5 pF
Interelectrode Capacitance (Grounded Grid)[2]	
Cin	17.0 pF
Cout	7.5 pF
Cpk	0.2 pF
Frequency of Maximum Rating (CW)	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	5-Pin Special
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-8
Recommended Air-System Socket	EIMAC SK-510
Recommended Air-System Chimney	EIMAC SK-516
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C

(Effective 8-15-74) © 1962, 1964, 1967, 1968, 1974 by Varian

Printed in U.S.A.

Maximum Overall Dimensions:

Height	7.875 In;	200.02 mm
Diameter	5.250 In;	133.35 mm
Net Weight	1.2 lb;	0.55 kg

RADIO FREQUENCY POWER AMPLIFIER

Class C, Grid Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	700	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

TYPICAL OPERATION

Plate Voltage	3000	4500	6000	Vdc
Grid Voltage	-30[1]	-75	-100	Vdc
Plate Current	700	700	700	mAdc
Grid Current[2]	230	240	250	mAdc
Peak RF Grid Voltage[2]	107	200	230	v
Grid Driving Power[2]	27	48	57	W
Output Power[2]	1300	2250	3200	W

1. Operating bias may be wholly derived from grid current flowing through 130 ohm, 25 watt resistor.
2. Approximate value.

PLATE MODULATED RF AMPLIFIER

Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4500	VOLTS
DC PLATE CURRENT	550	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	670	WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION[1]

Plate Voltage	4500	Vdc
Grid Voltage	-100	Vdc
Plate Current	500	mAdc
Grid Current[2]	170	mAdc
Drive Power[2]	35	W
Output Power (carrier)[2]	1765	W

RADIO-FREQUENCY LINEAR AMPLIFIER

Class B, Zero Bias, Cathode Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

1. Approximate value.
2. Referenced against one tone of a two-equal tone signal.

TYPICAL OPERATION

Plate Voltage	2500	3000	Vdc
Zero-Signal Plate Current[1]	162	240	mAdc
Max. Signal Plate Current	800	670	mAdc
Max. Signal Grid Current[1]	260	220	mAdc
Max. Signal Drive Power[1]	100	47	W
Plate Load Impedance	1760	2650	ohms
Nominal Cathode Impedance	65	67	ohms
Plate Output Power[1]	1050	1080	W
Intermodulation Distortion[2]			
Products: 3rd Order	-32	-29	dB
5th Order	-39	-37	dB

AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Class B

MAXIMUM RATINGS (per tube):

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	50	WATTS

1. Approximate Value. Adjust to provide stated zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
(Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000	5000	Vdc
Grid Voltage[1]	0	-13	Vdc
Zero-Signal Plate Current	350	200	mAdc
Max. Signal Plate Current	1450	1000	mAdc
Max. Signal Grid Current[2]	485	310	mAdc
Driving Power[2]	48	28	W
Peak AF Driving Voltage[2]	100	90	v
Load Resistance Plate to Plate	3940	10,200	ohms
Max. Sig. Plate Output Power[2]	2540	3560	W

RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Max.	
Filament Current, at 7.5 volts	20.0	22.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	160	260	mAdc
Cut-Off Voltage (Eb = 3000 Vdc; Ib = 1.0 mAdc)	---	-24.0	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	15.0	19.0	pF
Cout	---	0.30	pF
Cgp	6.0	9.0	pF
Interelectrode Capacitance (Grounded Grid Connection) [1]			
Cin	15.0	19.0	pF
Cout	6.0	9.0	pF
Cpk	---	0.30	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING - The 3-1000Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the EIMAC HR-8 Heat Dissipating Connector on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock. The EIMAC SK-510 socket or equivalent must be employed to prevent excess lateral pressure on base pins and seal of the tube.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-510 Air-System Socket and SK-516 Chimney, a minimum air flow rate of 25 cubic feet per minute at a static pressure of approximately 0.43 inch of water, as measured at the socket at sea level, is required to provide adequate cooling at an inlet air temperature of 50°C. Above 30 megahertz the required air flow is increased to 35 cubic feet per minute at a static pressure of approximately 0.8 inch of water, as measured at the SK-510 socket. Cooling air must be supplied to the tube even when the filament alone is on during stand-by periods.

When a socket other than the SK-510 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate seal. In all cases air flow rates in excess of the minimum requirements will prolong tube life.

FILAMENT OPERATION - The rated filament voltage for the 3-1000Z is 7.5 volts. Filament voltage, as measured at the socket, must be maintained within the range of 7.13 to 7.87 volts to obtain maximum tube life. Operation at reduced voltage decreases emission capability, but increases life expectancy.

INTERMODULATION DISTORTION - Typical Operating Conditions and Intermodulation Distortion Product values are derived from measurements made at 2 MHz and are referred to one tone of a two-tone test signal. As the driving signal is reduced below full peak envelope power, distortion products remain at, or better than, the indicated value.

CLASS C OPERATION - Although designed for Class B service, the 3-1000Z may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristics can be used to advantage in Class C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

ZERO-BIAS OPERATION - Operating at zero-bias is not recommended with plate voltages over 3500 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias opera-

tion as mentioned above under "Class-C Operation" is not available at plate voltages above 3500 volts. Straight Class-C or Class-B operation is, of course, permissible up to 6000 volts where other ratings are not exceeded.

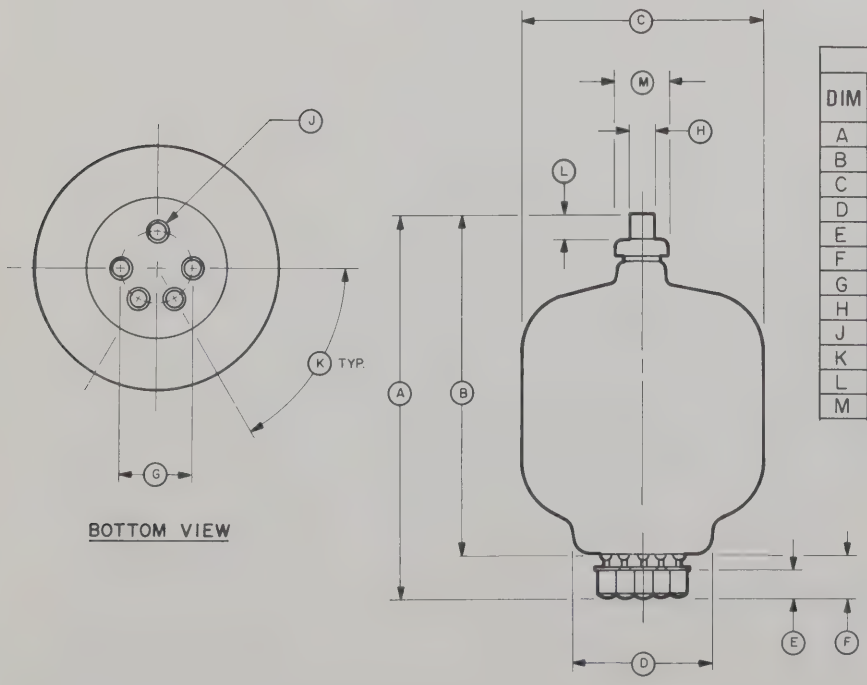
INPUT CIRCUIT - When the 3-1000Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 3-1000Z are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications; such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

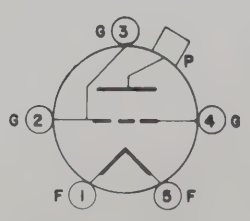
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

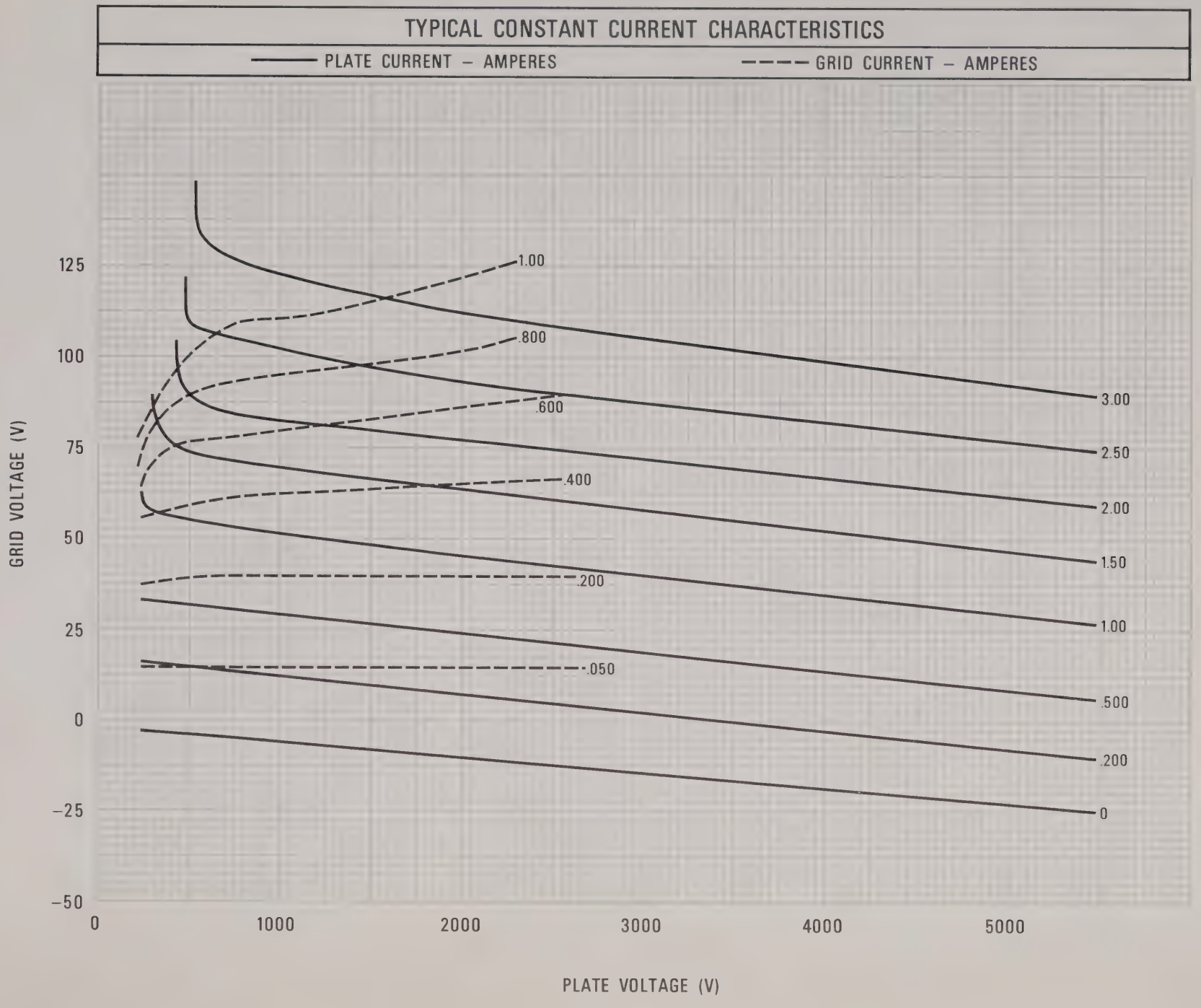
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

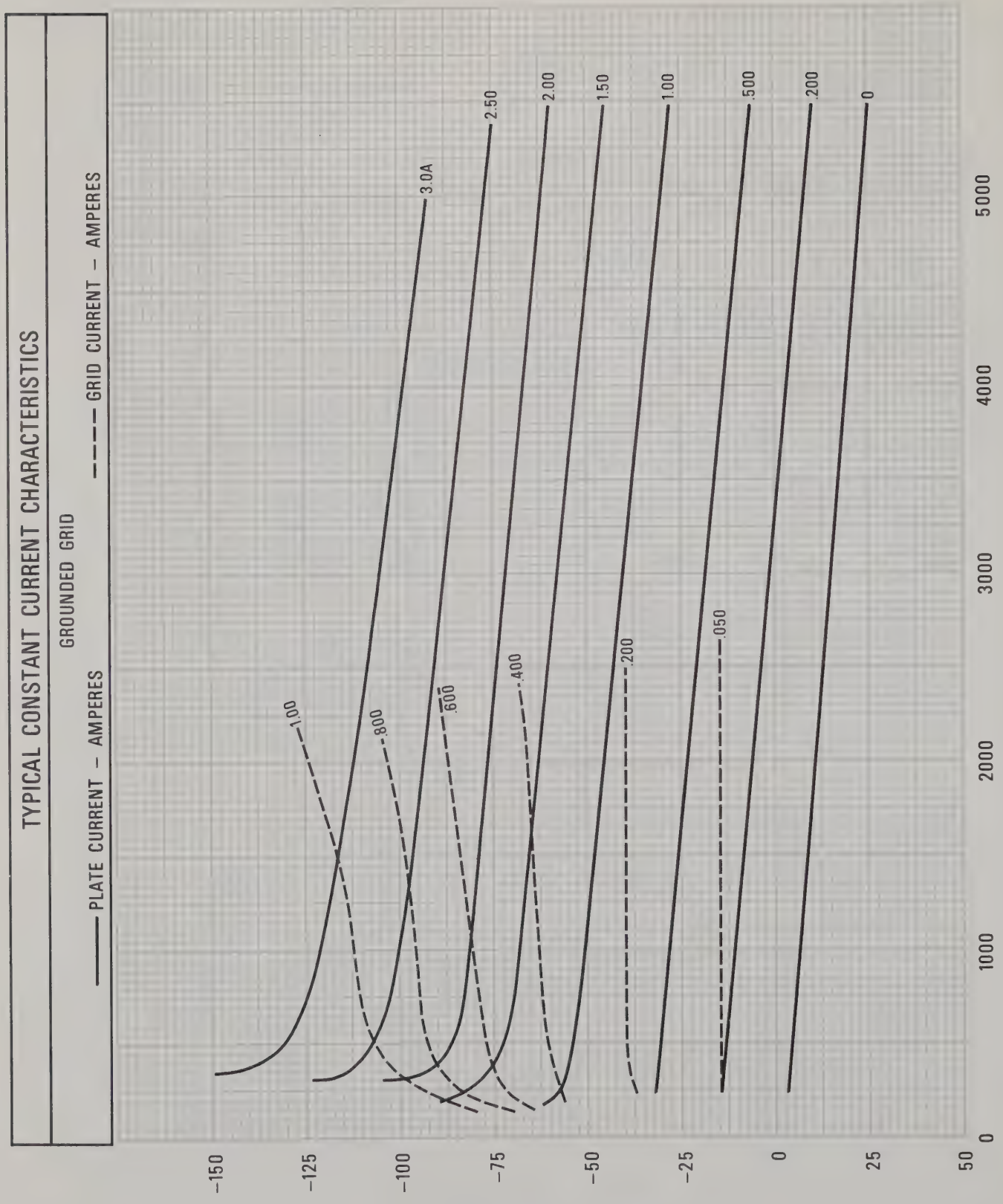


BOTTOM VIEW

DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.500	7.875	- -	190.5	200.0	- -
B	6.812	7.187	- -	173.0	182.5	- -
C	- -	5.250	- -	- -	133.3	- -
D	3.062	3.187	- -	77.77	80.95	- -
E	0.531	0.656	- -	13.49	16.66	- -
F	0.718	0.843	- -	18.24	21.41	- -
G	- -	- -	1.500	- -	- -	38.10
H	0.559	0.573	- -	14.20	14.55	- -
J	0.371	0.377	- -	9.42	9.57	- -
K	- -	- -	60°	- -	- -	60°
L	0.484	- -	- -	12.29	- -	- -
M	- -	- -	1.125	- -	- -	28.57




TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
125
100
75
50
25
0
–25
–50
0
1000
2000
3000
4000
5000
PLATE VOLTAGE (V)
1.00
.800
.600
.400
.200
.050
3.00
2.50
2.00
1.50
1.00
.500
.200
0


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
3.0A
2.50
2.00
1.50
1.00
.500
.200
0
1.00
.800
.600
.400
.200
.050
FILAMENT TO GRID VOLTAGE (V)
−150
−125
−100
−75
−50
−25
0
25
50
PLATE TO GRID VOLTAGE (V)
0
1000
2000
3000
4000
5000

TECHNICAL DATA

3CW20,000H7

WATER-COOLED
HIGH-MU
POWER TRIODE

The EIMAC 3CW20,000H7 is a ceramic/metal power triode intended for use as a dc voltage or current regulator, or in high-voltage switch tube or pulsed regulator service.

In addition, since the tube is identical to the EIMAC 3CW20,000A7 except for the anode and grid flanges and the addition of the filament flying leads, the tube is useful as a zero-bias Class B amplifier in audio or rf applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the tube.

The anode dissipation rating is 20,000 watts with water cooling.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.4	V
Current, at 7.5 V	100	A
Amplification Factor (Average)	200	
Direct Interelectrode Capacitances [2]		
Cin	59	pF
Cout	0.2	pF
Cgp	36	pF
Frequency of Maximum Rating (CW)	110	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special, with grid contact flange & filament flying leads
Operating Position	Vertical, Anode up or down
Cooling	Water or equivalent liquid & forced air

(Effective 5-15-74) © by Varian Printed in U.S.A.

Maximum Overall Dimensions:

Length (including filament leads)	20.7 in;	52.2 cm
Diameter (anode mounting flange pitch circle)	6.75 in;	17.1 cm

Maximum Operating Temperature:

Envelope & Ceramic/Metal Seals	250°C

Net Weight (Approximate)	10.6 lbs:	4.8 kg

DC VOLTAGE OR CURRENT REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20 KILOVOLTS	PLATE DISSIPATION	20 KILOWATTS
DC PLATE CURRENT	7.5 AMPERES	GRID DISSIPATION	500 WATTS

SWITCH TUBE OR PULSED REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20 KILOVOLTS	PLATE DISSIPATION	20 KILOWATTS
PULSE PLATE CURRENT	40 AMPERES	GRID DISSIPATION	500 WATTS

RADIO FREQUENCY LINEAR AMPLIFIER

Grounded Grid, Class B

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION, Single-Tone Conditions

Plate Voltage	7000	7000	Vdc
Zero-Signal Plate Current[1]	0.60	0.60	Adc
Max. Signal Plate Current	3.72	5.00	Adc
Max. Signal Grid Current[1]	0.71	1.00	Adc
Driving Impedance	35	32	Ω
Resonant Load Impedance	1020	745	Ω
Max. Signal Driving Power[1]	885	1540	W
Peak Envelope Plate Output Power	17.7	24.2	kW
Power Gain[1]	20.0	15.7	times

AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Class B, Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION
Two Tubes, Sinusoidal Wave

Plate Voltage	5000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current[1]	0.8	1.2	Adc
Max. Signal Plate Current	10.0	10.0	Adc
Max. Signal Grid Current[1]	1.2	2.1	Adc
Driving Power[1]	290	560	W
Peak Audio Driving[1] Voltage (per tube)	240	310	v
Load Resistance, plate-to-plate	1030	1520	Ω
Max. Signal Plate Output Power[1]	31.0	47.7	kW

RADIO FREQUENCY LINEAR AMPLIFIER (AM DOUBLE SIDEBAND)

Carrier Conditions, Grounded-Grid Class B

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.
2. Modulation Crest Conditions.

TYPICAL OPERATION

Plate Voltage	7000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[1]	0.6	Adc
Plate Current	2.4	Adc
Grid Current[1]	0.25	Adc
Driving Impedance[2]	32	Ω
Peak Driving Voltage[2]	310	v
Driving Power[1]	330	W
Plate Output Power[1]	5650	W

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	7000 VOLTS
PLATE CURRENT	4.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	5000	7000	Vdc
Plate Current	4.0	4.0	Adc
Grid Voltage	-210	-230	Vdc
Grid Current[1]	840	775	mAdc
Peak rf Grid Voltage	510	555	v
Grid Driving Power	420	530	W
Plate Output Power[1]	14	21.3	kW

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current @ 7.5 Volts	94.0	104.0	A
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	53.0	65.0	pF
Cout	---	0.30	pF
Cgp	32.0	40.0	pF
Interelectrode Capacitance[1] (grounded grid connection)			
Cin	53.0	65.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.30	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 3CW20,000H7 must be operated vertically, anode down or up, and should be protected from shock and vibration. The anode mounting flange provides a convenient mounting means, and the grid is also provided with a flange for mating with a simple contact assembly. Both filament connections are made with flying leads approximately nine inches long with heavy lugs attached at the ends.

COOLING - The anode of the 3CW20,000H7 is cooled by circulating water through the integral anode water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes a temperature rise for the water of 10°C. Inlet water temperature should never exceed 55°C and outlet water temperature should never exceed 70°C. Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure must not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop Approx. psi
10	11.0	11.5
15	12.0	13.5
20	14.0	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 $K\Omega/cm^3$, and preferably above 250 $K\Omega/cm^3$. A relative water resistance check can be made continuously by

measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with 30 to 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the grid and filament contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the terminals with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 3CW20,000H7 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 3CW20,000H7 by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate.

INPUT CIRCUIT - When the 3CW20,000H7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of two or more.

CLASS-C OPERATION - Although designed specifically for Class-B service,the 3CW20,000H7 may be operated as a Class-C amplifier or oscillator or as a plate-modulated radio-frequency amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power should fail, plate dissipation is then kept to a low value because the tube will be operating at normal, static, zero-bias conditions.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

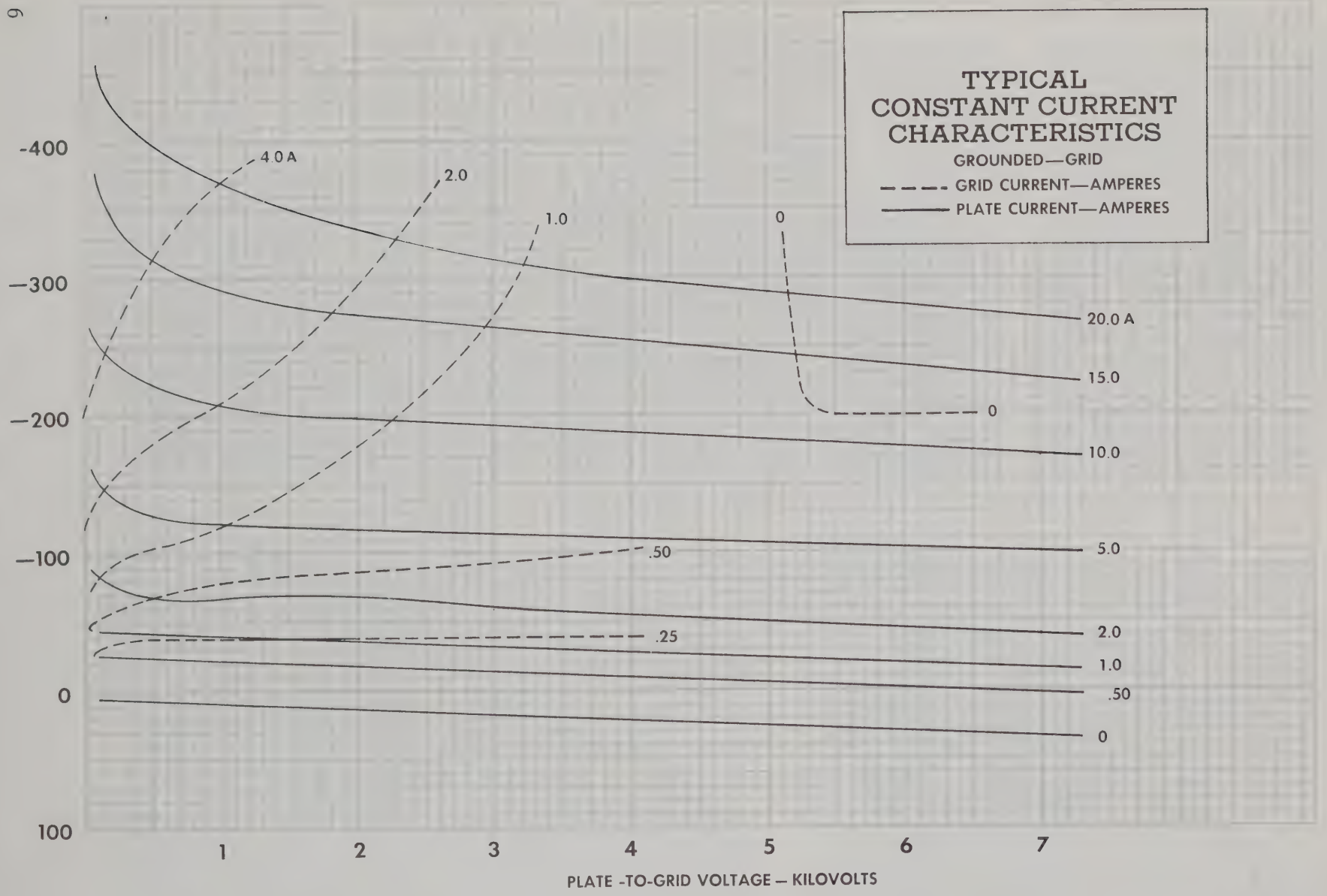
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

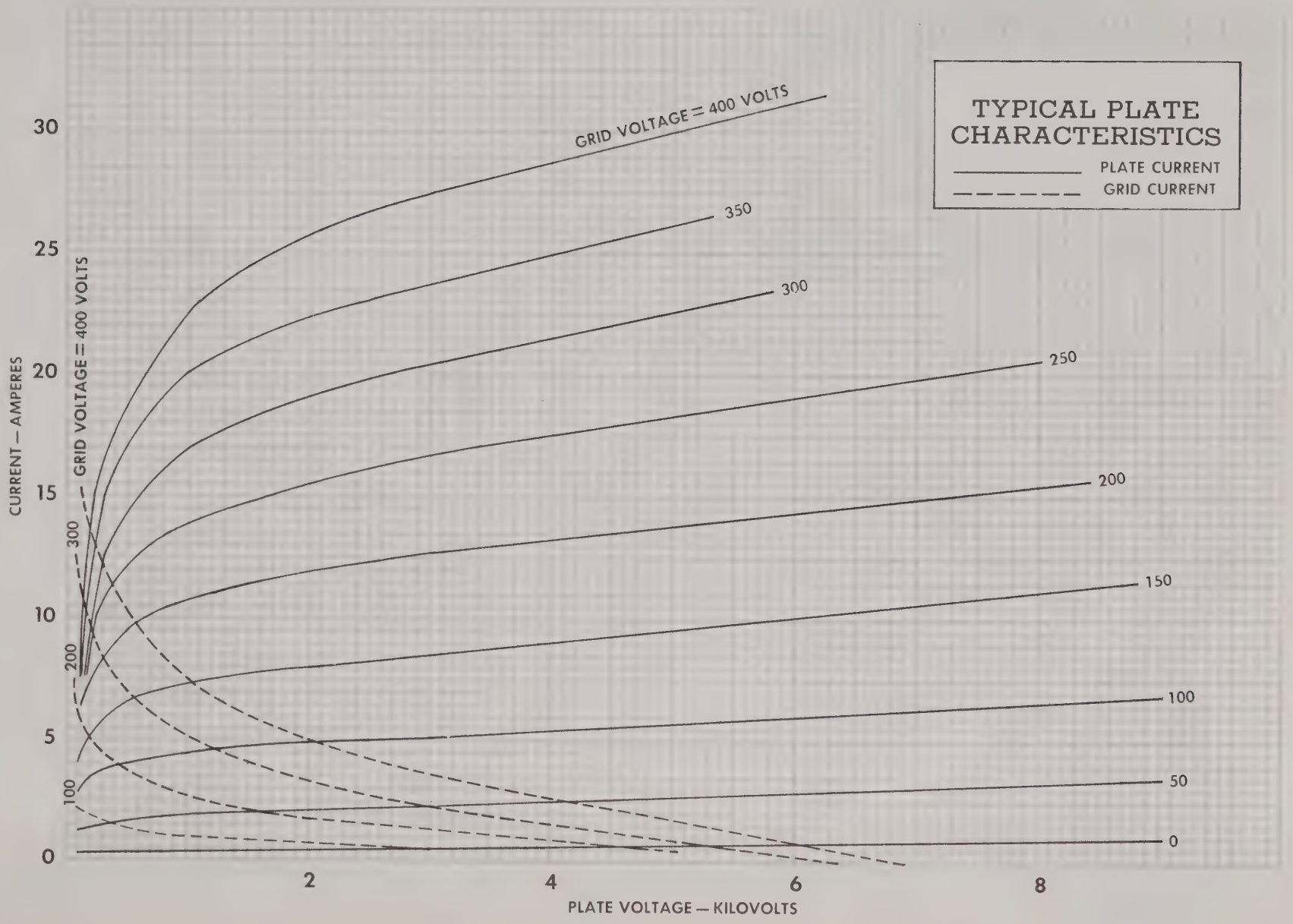
Many EIMAC power tubes, such as the 3CW-20,000H7, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power invloved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION - In addition to normal plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

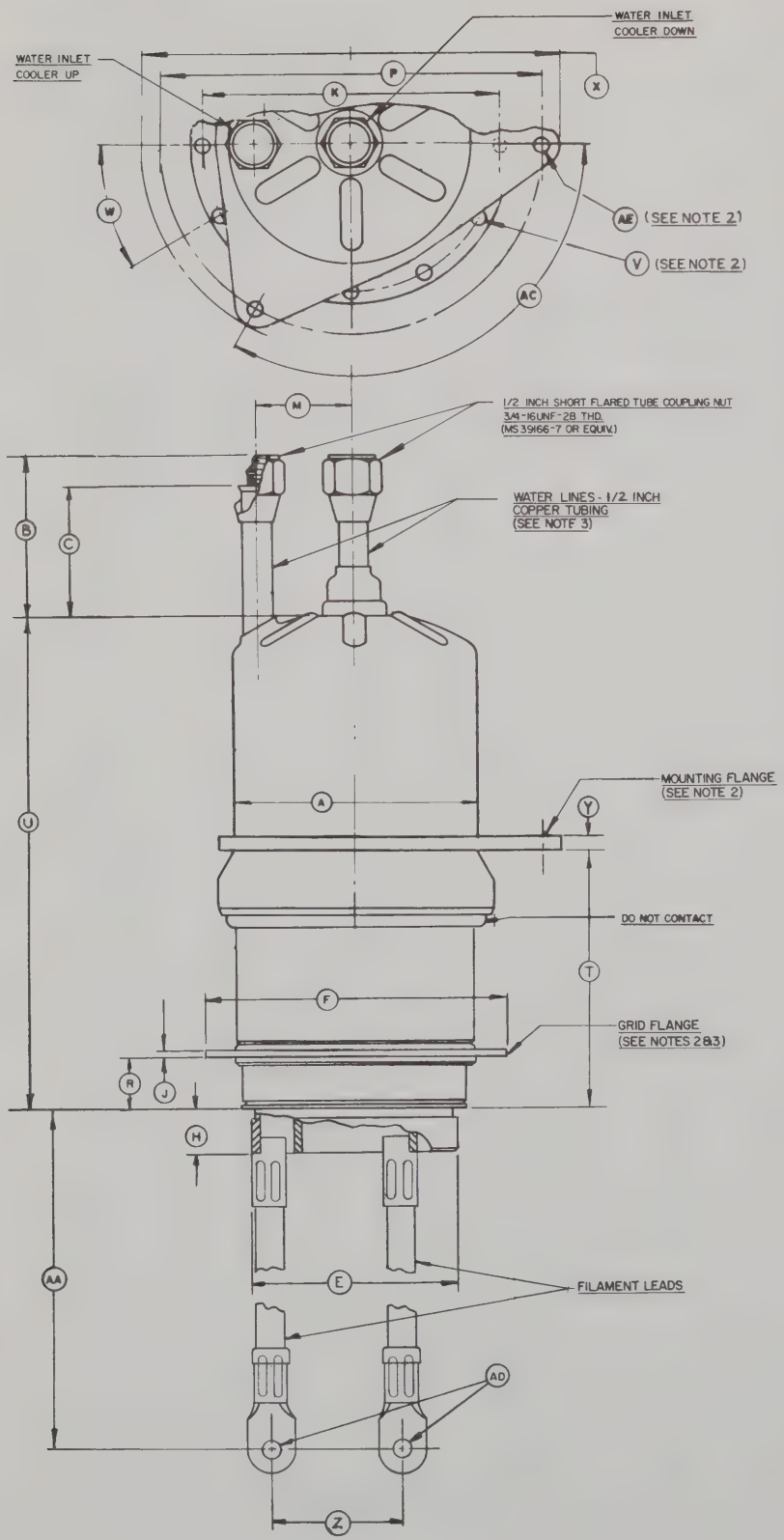
In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
FILAMENT-TO-GRID VOLTAGE — VOLTS
-400
-300
-200
-100
0
100
4.0 A
2.0
1.0
0
20.0 A
15.0
0
10.0
5.0
.50
.25
2.0
1.0
.50
0
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE — KILOVOLTS


TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 400 VOLTS
350
300
250
200
150
100
50
0
300
200
100
CURRENT — AMPERES
PLATE VOLTAGE — KILOVOLTS
0
5
10
15
20
25
30
2
4
6
8

3CW20,000H7



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN	MAX	REF
A	4.094	4.156	- -	103.99	105.56	- -
B	2.312	2.812	- -	56.72	71.42	- -
C	1.937	2.187	- -	49.20	55.55	- -
E	3.230	3.270	- -	82.04	83.06	- -
F	5.030	5.090	- -	127.76	129.29	- -
H	0.530	0.700	- -	13.46	17.78	- -
J	- -	- -	0.125	- -	- -	3.18
K	4.425	4.445	- -	112.40	112.90	- -
M	1.500	1.750	- -	38.10	44.45	- -
P	5.957	6.025	- -	151.31	153.04	- -
R	0.700	0.860	- -	17.78	21.84	- -
T	4.350	4.450	- -	110.49	113.03	- -
U	7.903	8.403	- -	200.74	213.44	- -
V	- -	- -	0.250	- -	- -	6.35
W	29°	31°	- -	29°	31°	- -
X	- -	- -	6.750	- -	- -	171.45
Y	- -	- -	0.250	- -	- -	6.35
Z	- -	- -	2.000	- -	- -	50.80
AA	8.500	9.000	- -	215.90	228.60	- -
AC	118°	122°	- -	118°	122°	- -
AD	- -	- -	0.390	- -	- -	9.91
AE	- -	- -	0.265	- -	- -	6.73

NOTES:
1. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQ'D FOR INSPECTION PURPOSES.
2. 3 MTG. HOLES IN MTG FLANGE AND 12 IN THE GRID FLANGE.
3. GRID FLANGE, WATER FITTINGS, AND FIL. LEADS ORIENTED AS SHOWN.

TECHNICAL DATA

3CX400U7

HIGH-MU UHF TRANSMITTING TRIODE



The EIMAC 3CX400U7 is designed for use above 200 MHz as a CW, pulse, or linear rf amplifier, particularly in the 806 to 950 MHz portion of the spectrum allocated to land mobile services.

The 3CX400U7 is a high-mu triode designed with beam-forming cathode and control grid geometry, of all metal/ceramic construction, and an external anode rated for 400 watts of dissipation with forced-air cooling.

The combination of an amplification factor of over 200 and minimum current interception by the control grid provides good power gain in cathode-driven (grounded grid) amplifiers. Coaxial terminals and continuous cone-shaped conductors for the grid and cathode allow the lowest possible inductance between these tube elements and the cavity. The heater terminals are separate from the cathode.

200 watts of useful CW rf power may be obtained with better than 33% efficiency, and better than 10 dB of gain. At frequencies near 900 MHz the amplifier circuit may be essentially a quarter-wave radial or rectangular resonator for the anode, and a three-quarter wave coaxial line section between ground and cathode. The amplifier is described in this data sheet. Terminal collets are available and are listed.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-Coated, Unipotential		
Heater Voltage, Nominal (see derating table for UHF use)	6.3 ± 0.3	V
Heater Current, at 6.3 volts	3.0	A
Cathode-Heater Potential, Maximum	±150	V
Transconductance, average (I_b = 250 mAdc)	29,000	μmhos
Amplification Factor, average	240	
Direct Interelectrode Capacitances (grid grounded)[2]		
Cin	18.4	pF
Cout	6.1	pF
Cpk	0.07	pF
Ck-htr	6.0	pF
Frequency of Maximum Rating:		
CW	1000	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Effective 8-1-74) © 1974 by Varian Printed in U.S.A.

MECHANICAL

Maximum Operating Temperature:
- Ceramic/Metal Seals and Anode Core ..... 250°C

Cooling ..... Forced Air

Base ..... Special Coaxial

Recommended Contact Collets:

Tube Element	EIMAC Part No.
Inner Heater	008290
Outer Heater	008291
Cathode	008292
Grid	882931
Anode	154418

Maximum Overall Dimensions:
- Length ..... 2.51 in; 63.75 mm
- Diameter ..... 2.08 in; 52.83 mm

Net Weight (approximate) ..... 5.5 oz; 155 gms

RADIO FREQUENCY POWER AMPLIFIER CLASS C TELEGRAPHY OR FM

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	-100 VOLTS
DC PLATE CURRENT	0.400 AMPERE
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	5 WATTS

TYPICAL OPERATION, Cathode Driven, 850 MHz

Plate Voltage	1500 Vdc
Plate Current	400 mAdc
Grid Current	-5 mAdc
Measured Driving Power	13.0 W
Useful Output Power	225 W
Efficiency	37 %
Power Gain	12 dB

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	2.8	3.4	A
Cathode Warmup Time	60	---	Sec
Interelectrode Capacitances (grid grounded)[1]			
Cin	16.0	21.0	pF
Cout	5.0	7.0	pF
Cpk	---	0.1	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - Part numbers of available EIMAC collets are listed under MECHANICAL. These collets may be soft-soldered to the appropriate UHF line or cavity elements. The collets provide low-inductance connections between tube and circuitry and serve to draw off a portion of the heat released during normal operation.

HEATER-CATHODE OPERATION - The nominal heater voltage for the 3CX400U7 is 6.3 volts. For CW operation at frequencies above 300 MHz the heater voltage should be reduced as the cathode receives additional heat from rf charging currents and a transit-time effect. The following table gives approximate values of heater voltage recommended versus operating frequency for CW

power levels at, or near, the typical operating conditions shown on Page 2. It is recommended that a mechanical relay, or other type of switching device, be provided so that near-nominal heater voltage will be provided during warmup and standby periods, and then dropped to the recommended level when rf drive is applied to the amplifier.

Frequency (MHz)	Heater Volts
300 or lower	6.3
300 to 400	6.1
400 to 500	5.7
500 to 600	5.3
600 to 700	4.9
700 to 800	4.5
800 to 900	4.0
900 to 1000	3.6

The heater voltage should be operated at nominal voltage of 6.3 volts for a minimum of 60 seconds before application of plate voltage or rf driving voltage.

INTERLOCKS - An interlock device should be provided to insure that cooling air flow is established before application of electrical power, including the heater. The circuit should be so arranged that rf drive cannot be applied in the absence of normal plate voltage.

COOLING - Forced-air cooling of the tube is required, with 11.5 cfm of air directed through the anode cooler when operating at full rated (400 W) dissipation. The pressure drop across the anode cooler only at this flow rate is approximately 0.2 inch of water, and these figures are based on an incoming air temperature of 50°C and a maximum tube anode temperature of 225°, at sea level, and with air flowing in a base-to-anode direction. When air is flowing in this direction, and the base contacting arrangement does not restrict flow in and around the base seals, additional base cooling provisions may not be required, but the designer is cautioned to verify whether base cooling is adequate before a circuit design is finalized, by means of temperature-sensitive paints which are available for this purpose, or other equivalent means.

Depending on the circuit or cavity design, allowance must also be made for other losses in the air system, in order to always assure sufficient flow for tube cooling. The designer is also cautioned that it is not good practice to operate at, or very close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined is normally beneficial.

UHF CAVITY AMPLIFIER - Included in this data sheet is an exploded view of a typical cavity amplifier of simple construction requiring little precise machine work. The dimensions shown are for an amplifier to be operated near 900 MHz. The typical operating conditions for 850 MHz, shown on Page 2, were obtained with this cavity.

The output circuit is essentially a quarter-wave rectangular cavity forming the tuned circuit between anode and grid. Output coupling is magnetic. A loop is formed by a post *F* which terminates at one end in the center conductor of the coaxial fitting, and at the other end it is solidly in contact with the opposite plate (or wall) of the cavity.

The input circuit, while simple mechanically, is not as easily visualized as an electrical circuit. Starting with the small inner conductor *A*, this is a heater conductor and rf choke. The next tube, *B*, is the second heater conductor and rf choke. The third tube, *C*, is the cathode line which may be considered as a broadly tuned three-quarter wave line. The next diameter of tubing, *D*, is a sleeve tuned to an electrical three-quarter wave-length by an adjustable capacity probe, *E*. The sleeve is excited by the input capacity probe, *F*. Current flows on the inside as well as on the outside wall of the three-quarter wave sleeve, thereby coupling energy to the cathode line. Sleeve *D* is electrically three-quarter wavelength because there is approximately a loaded quarter wavelength within the vacuum tube itself, *E*.

Suitable cowling (not shown) should be provided to introduce cooling air through three short tubes on each side of the output cavity for anode cooling. The air then exhausts through the anode cooling fins of the 3CX400U7. The three short tubes on each side of the cavity are dimensioned to serve as waveguide-above-cutoff frequency filters in the air openings.

HIGH VOLTAGE - Normal operating voltages used with the 3CX400U7 are deadly, and the equipment must be designed properly and opera-

ting precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

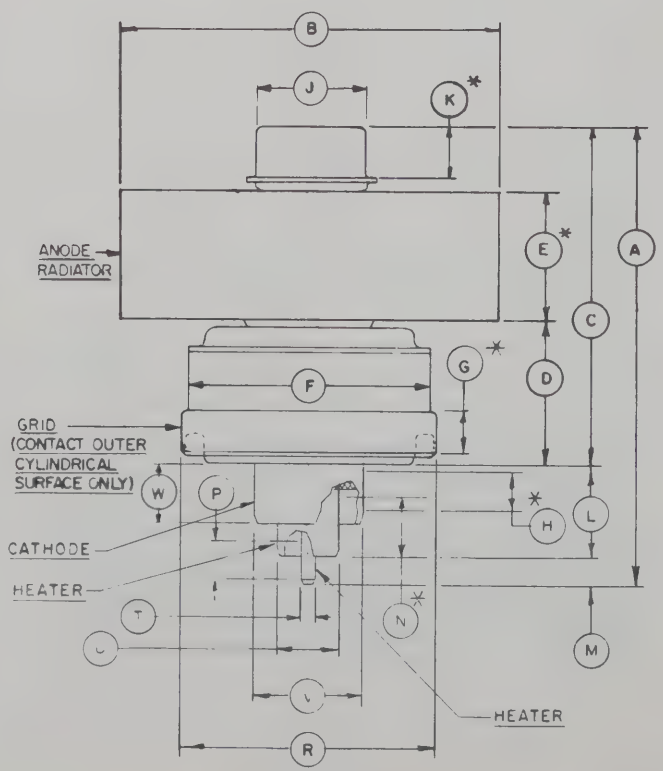
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

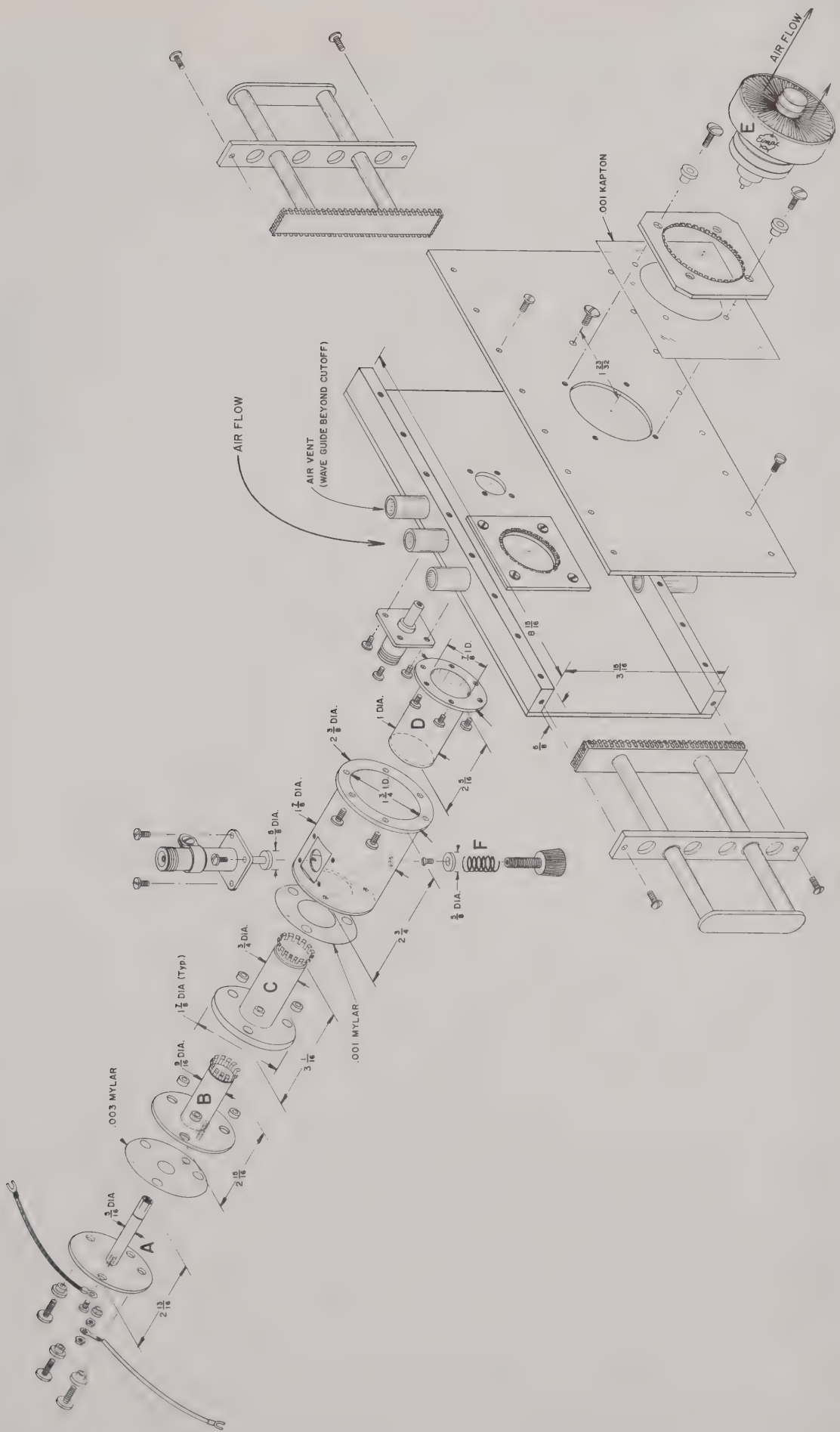
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	2.510	- -	- -	63.75
B	2.050	2.080	- -	52.07	52.83	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	0.200	- -	- -	5.08	- -	- -
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.500	- -	- -	12.70
M	- -	- -	0.150	- -	- -	3.81
N	0.330	- -	- -	8.38	- -	- -
P	0.230	- -	- -	5.84	- -	- -
R	1.417	1.433	- -	35.99	36.40	- -
T	0.091	0.095	- -	2.31	2.41	- -
U	0.318	0.325	- -	8.08	8.25	- -
V	0.588	0.597	- -	14.93	15.16	- -
W	- -	- -	0.325	- -	- -	8.25

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.

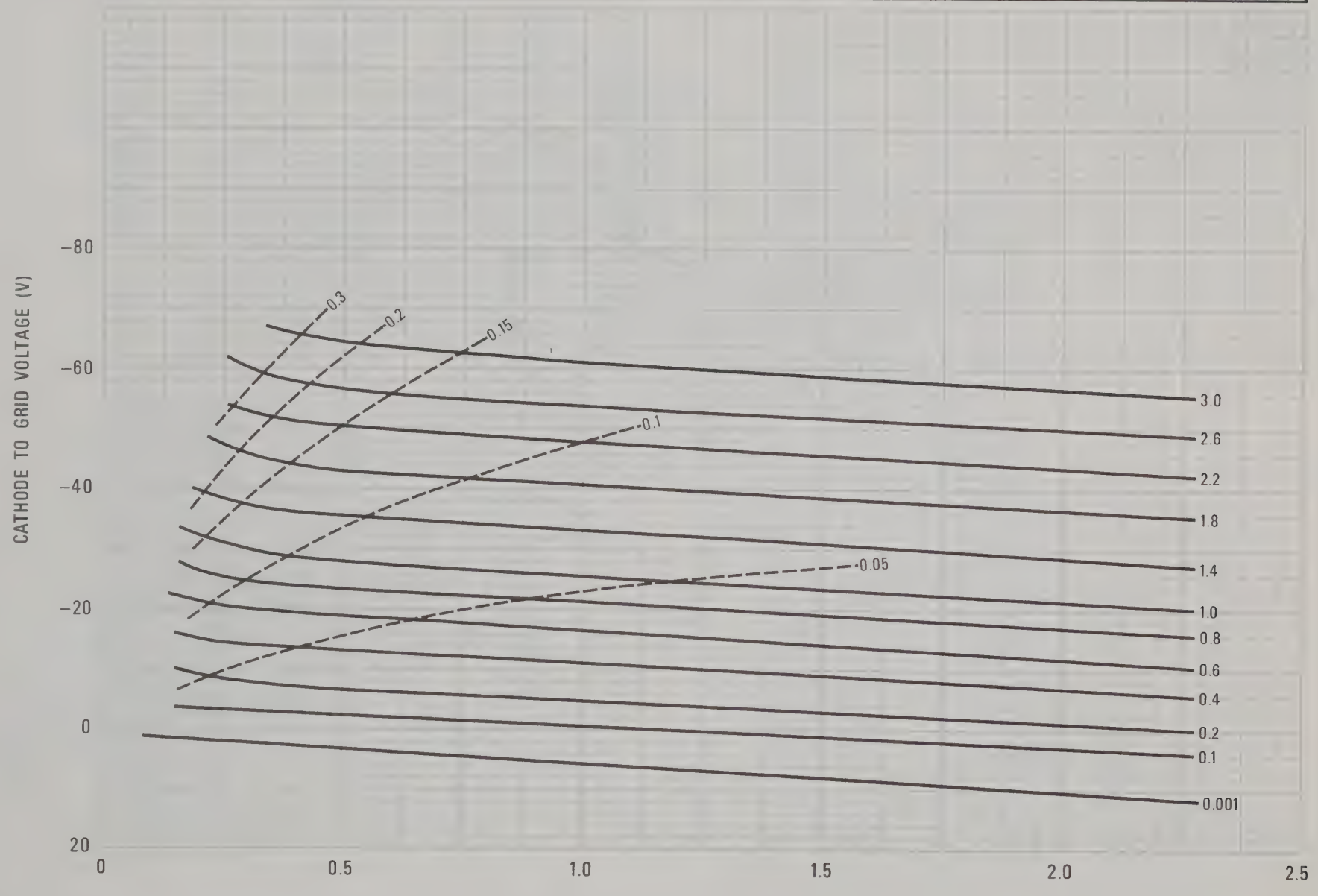



AIR FLOW
.001 KAPTON
AIR VENT
(WAVE GUIDE BEYOND CUTOFF)
AIR FLOW
.003 MYLAR
.001 MYLAR
A
B
C
D
E
F

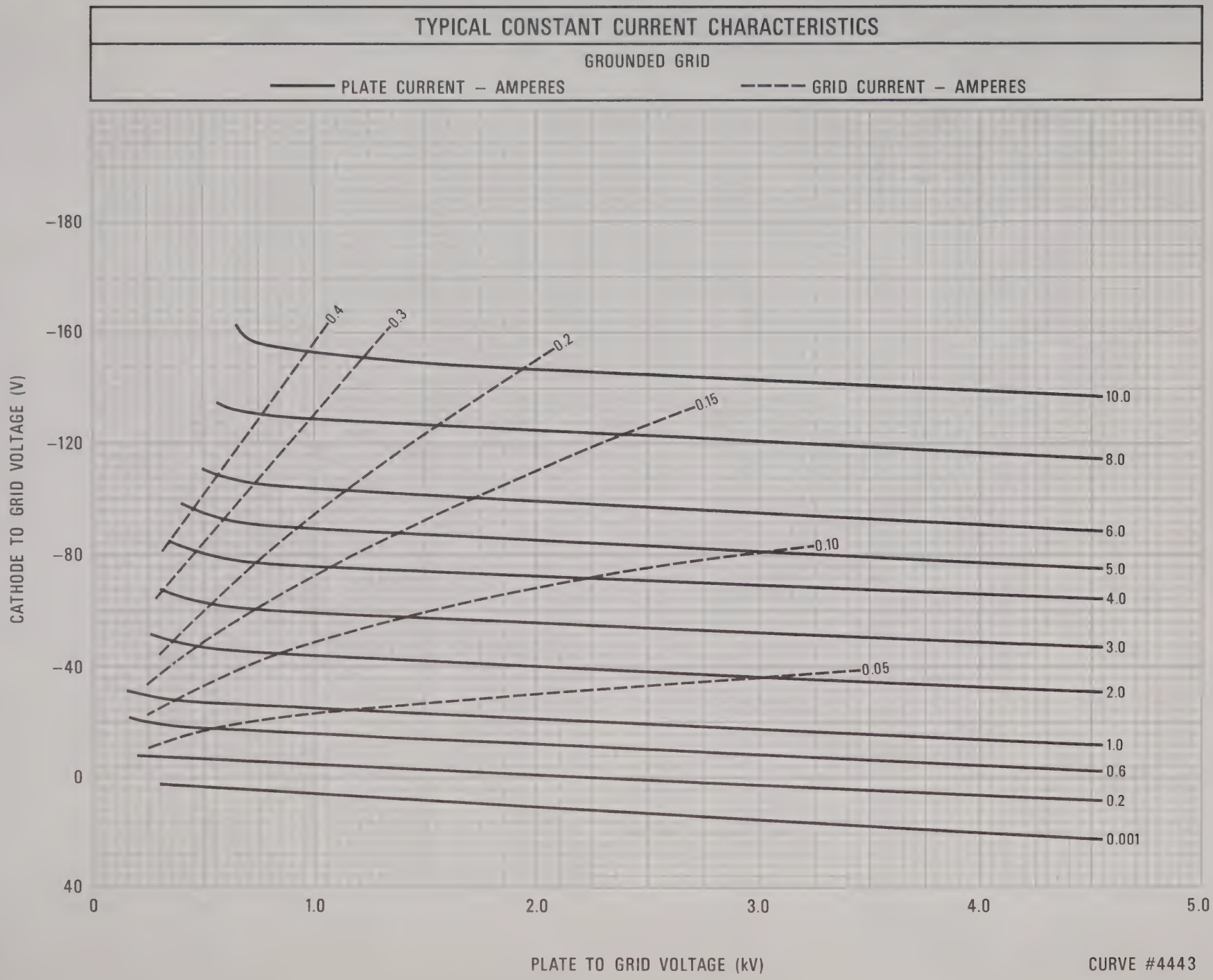
TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED GRID

——— PLATE CURRENT – AMPERES – – – – GRID CURRENT – AMPERES



CURVE #4442


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
-180
-160
-120
-80
-40
0
40
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
0.4
0.3
0.2
0.15
0.10
0.05
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
CURVE #4443

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

1-15-75

(Effective 1-15-75) © 1975 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 5-1-74
Index 5-1-74
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 5-1-74
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 5-1-74
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 11-15-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 8-15-74
3-500Z 11-1-73
3-1000Z/8164 8-15-74
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 1-11-74
3CW5000F3/8243 . . . . . see 3CW5000A3
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW20,000H7 5-15-74
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX400U7/8961 8-1-74
3CX1000A7/8283 11-1-68
3CX1500A7/8877 8-1-73
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7480	11-1-68
8873/8874/8875	6-3-73
8938	5-15-73

TETRODES

4-65A/8165	5-1-62
4-125A/4D21	6-1-67
4-250A/5D22	5-5-70
4-400A/8438	7-20-70
4-400C/6775	4-1-71
4-500A	3-10-72
4-1000A/8166	10-30-66
4CN15A	6-1-68
4CPX250K/8590	4-1-70
4CS250R	9-1-70
4CV8000A	3-15-71
4CV20,000A	6-1-68
4CV35,000A	5-15-66
4CV50,000E	5-1-70
4CV50,000J	7-15-71
4CV100,000C/8351	2-1-68
4CV250,000A	3-1-72
4CW800B/F	11-1-73
4CW2000A/8244	6-15-71
4CW10,000A/8661	4-15-63
4CW25,000A	2-1-72
4CW50,000E	7-1-70
4CW50,000J	7-15-71
4CW100,000D	7-1-67
4CW100,000E	9-1-70
4CW250,000A	3-1-71
4CX125C/F	6-1-67
4CX250B/7203 & 4CX250FG/8621	8-1-74
4CX250BC/8957	1-1-74
4CX250K/8245 & 4CX250M/8246	5-1-68
4CX250R/7580W	6-16-61
4CX300A/8167	8-30-66
4CX300Y/8561	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX350FJ/8904	9-1-71
4CX600B & 4CX600F	3-20-70
4CX600J/8809 & 4CX600JA/8921	8-15-71
4CX1000A/8168	5-1-70
4CX1000K/8352	8-20-66
4CX1500A	12-1-71
4CX1500B/8660	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	4-15-71
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	12-1-70
4W300B/8249	11-1-73
4X150A/7034 & 7609	8-1-74
4X150G/8172	10-15-73
4X500A	1-1-64
6816,6884,7843	11-15-71
7609	see 4X150A/7034
8560A	7-15-71
8876	6-15-71
8930	12-1-73
8954	6-1-74
8959	11-1-74
X2159	7-1-73

PENTODES

5-125B/4E27A	8-15-52
5-500A	5-1-68
5CX1500A	6-6-70
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

PULSE MODULATORS

4PR60C/8252W	6-30-71
4PR65A/8187	2-15-63
4PR125A/8247	3-15-64
4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6	4-4-70
Preformed Contact Finger Stock	6-15-71
HR Heat Dissipating Connectors	12-1-65
SK-300A	4-15-69
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73
SK-410	12-1-73
SK-500	3-15-67
SK-506, SK-516	4-15-69
SK-510	6-15-71
SK-600A, SK-610A	6-15-71
SK-606, SK-626, SK-636B, SK-646	11-1-74
SK-607	8-15-71

(Cont'd)

OTHER PRODUCTS

SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A, SK-712A	3-15-71
SK-740	8-15-66
SK-760, SK-770	7-27-70
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-860, SK-870	3-15-67
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210	8-15-72

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

1-15-75

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000F3/8243	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW20,000H7	T
3CW30,000H3	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX400U7	T
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203 & 4CX250FG/8621	TET
4CX250BC/8957	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4X150A/7034 see 7609	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7609 see 4X150A/7034	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
8954	TET
8959	TET
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-646 see SK-606	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
X-2150	TET
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

TECHNICAL DATA

7203
4CX250B
8621
4CX250FG

RADIAL-BEAM
POWER TETRODE

The 7203/4CX250B and 8621/4CX250FG are ceramic/metal forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 7203/4CX250B is designed to operate with a heater voltage of 6.0 volts, while the 8621/4CX250FG is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage (4CX250B)	6.0 ± 0.3	V
Current, at 6.0 volts	2.6	A
Cathode-Heater Potential, maximum	±150	V
Heater: Voltage (4CX250FG)	26.5 ± 1.3	V
Current, at 26.5 volts	0.54	A
Cathode-Heater Potential, maximum	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded cathode)[2]		
Input	15.7	pF
Output	4.5	pF
Feedback	0.04	pF
Direct Interelectrode Capacitances (grounded grid and screen)[2]		
Input	13	pF
Output	4.5	pF
Feedback	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.46 in; 62.5 mm
Diameter	1.64 in; 41.7 mm
Net Weight	4 oz; 113 gm
Operating Position	Any

(Revised 8-1-74) © 1962, 1970, 1973, 1974 Varian

Printed in U.S.A.

Maximum Operating Temperature:
- Ceramic/Metal Seals . . . . . 250°C
- Anode Core . . . . . 250°C

Cooling . . . . . Forced Air
Base . . . . . Special 9-pin JEDEC-B8-236
Recommended Socket . . . . . EIMAC SK-600 Series
Recommended Chimney . . . . . EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current [2]	10	8	5	mAdc
Two-Tone Screen Current [2]	2	-1	-2	mAdc
Single-Tone Grid Current [2]	0	0	0	mAdc
Peak rf Grid Voltage [2]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage [2]	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current

2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)					500 MHz [2]	
Plate Voltage	500	1000	1500	2000	2000	Vdc
Screen Voltage	250	250	250	250	300	Vdc
Grid Voltage	-90	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	250	mAdc
Screen Current [1]	45	38	21	19	10	mAdc [2]
Grid Current [1]	35	31	28	26	10	mAdc [2]
Peak rf Grid Voltage [1]	114	114	112	112	---	v
Measured Driving Power [1]	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Plate Output Power	70	190	280	390	290	W [2]
Heater Voltage (4CX250B)	6.0	6.0	6.0	6.0	5.5	V
Heater Voltage (4CX250FG)	26.5	26.5	26.5	26.5	24.3	V

1. Approximate value.
2. Measured values for a typical cavity amplifier circuit.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[1]	165	WATTS
SCREEN DISSIPATION[2]	12	WATTS
GRID DISSIPATION[2]	2	WATTS

1. Corresponds to 250 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current	31	22	20	mAdc
Grid Current	15	14	14	mAdc
Peak rf Grid Voltage	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	300	W
Plate Output Power	60	145	235	W

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1/3	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max.	
Heater: 4CX250B Current at 6.0 volts	2.3	---	2.9	A
Heater: 4CX250FG Current at 26.5 volts	0.45	---	0.62	A
Cathode Warmup Time	30	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)				
Input	14.2	---	17.2	pF
Output	4.0	---	5.0	pF †
Feedback	---	---	0.06	pF
Interelectrode Capacitances[1] (grounded grid and screen)				
Input	---	13.0	---	pF
Output	4.0	---	5.0	pF †
Feedback	---	0.01	---	pF

† Cout values shown are for 4CX250B; for 4CX250FG, values are ..... 4.0 --- 5.3 pF

APPLICATION

MECHANICAL

MOUNTING - The 4CX250B and 4CX250FG may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation(watts)	Air Flow (CFM)	Pressure Drop(In.of water)	Air Flow (CFM)	Pressure Drop(In.of water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1 20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this are expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 4CX250B and 4CX250FG is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below;

Frequency MHz	4CX250B	4CX250FG
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.3 volts
401 to 500	5.50 volts	24.3 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for

amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an a equate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250B or 4CX250FG.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

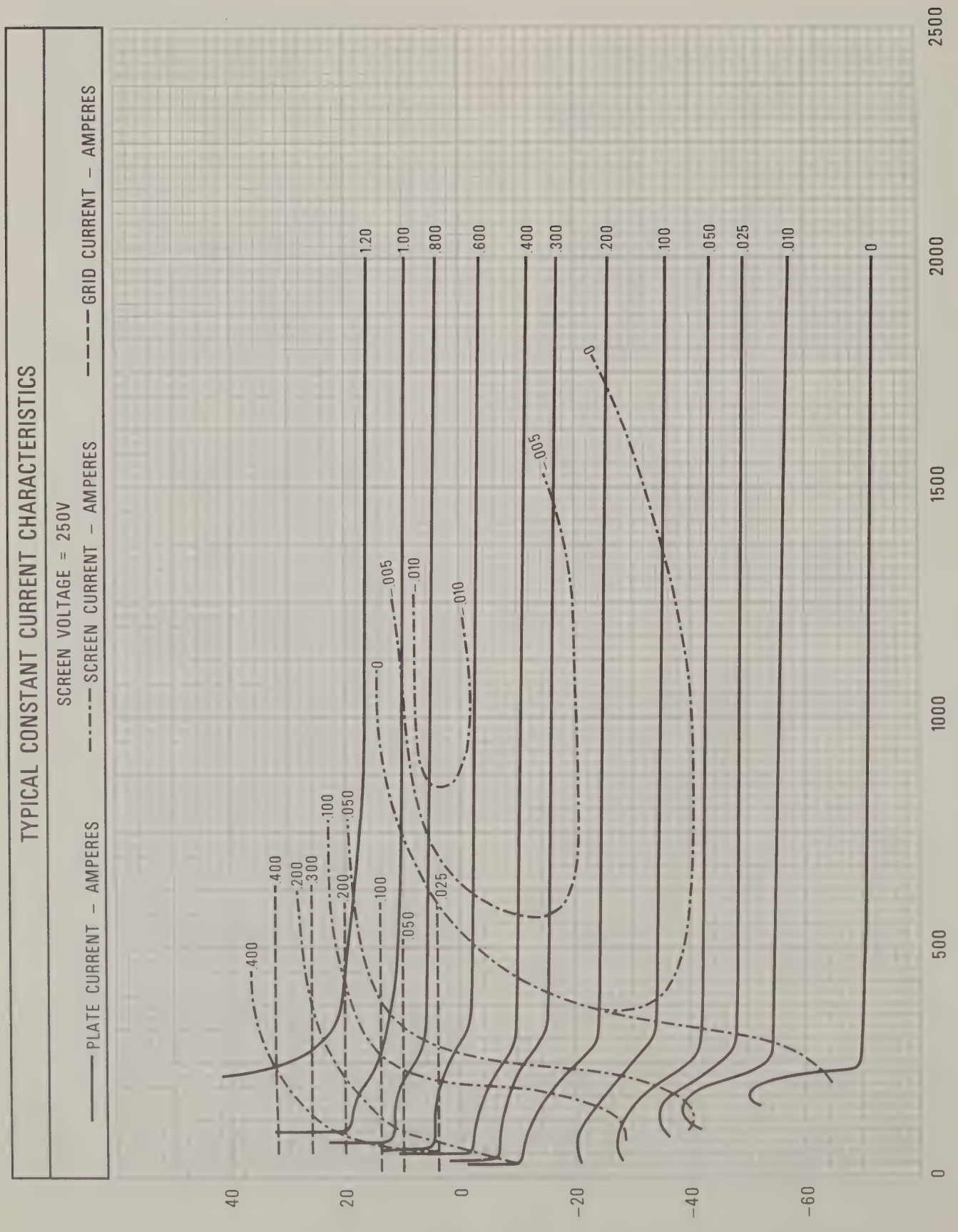
MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

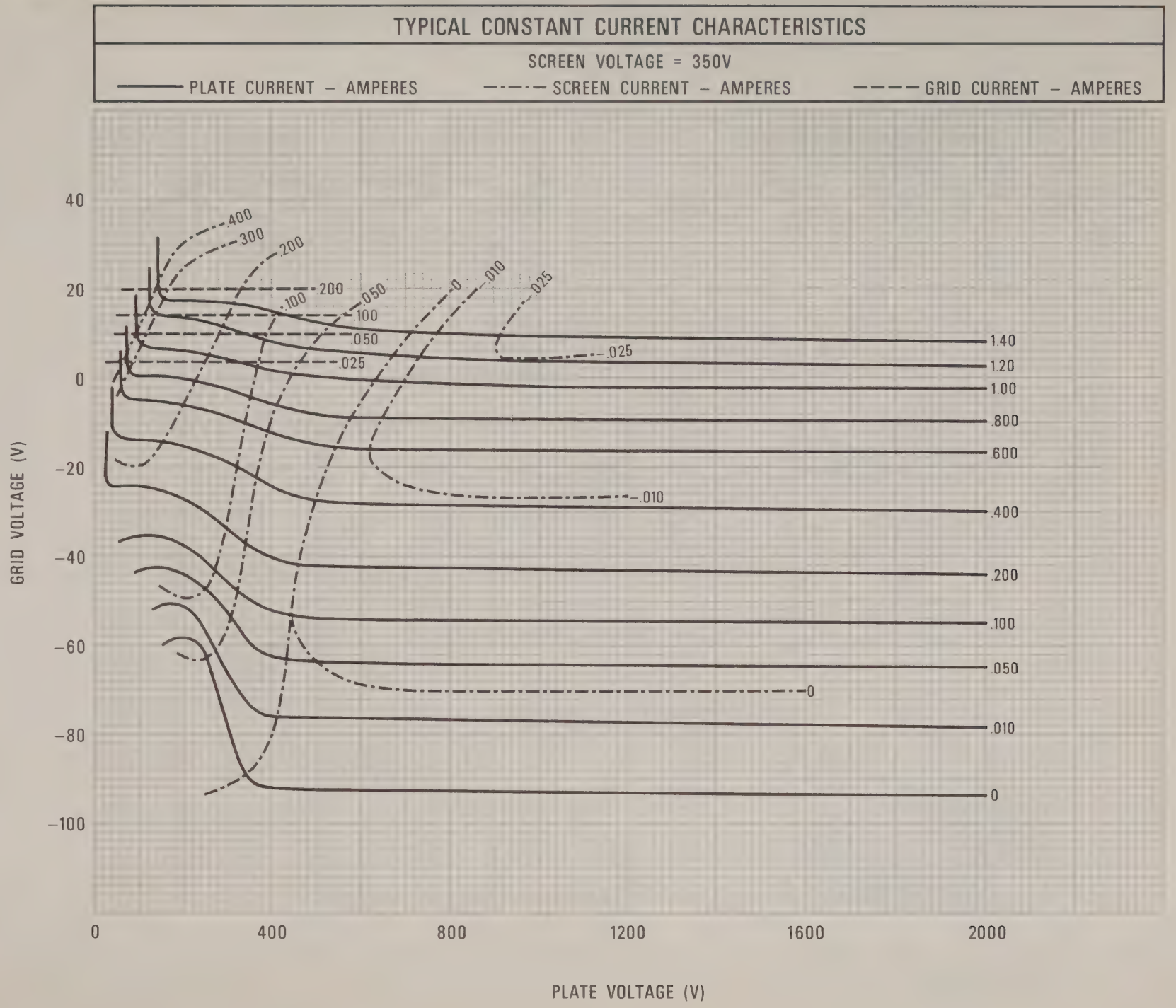
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

VHF OPERATION-The 4CX250B and 4CX250FG are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

HIGH VOLTAGE - The 7203/4CX250B and 8621/4CX250FG operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

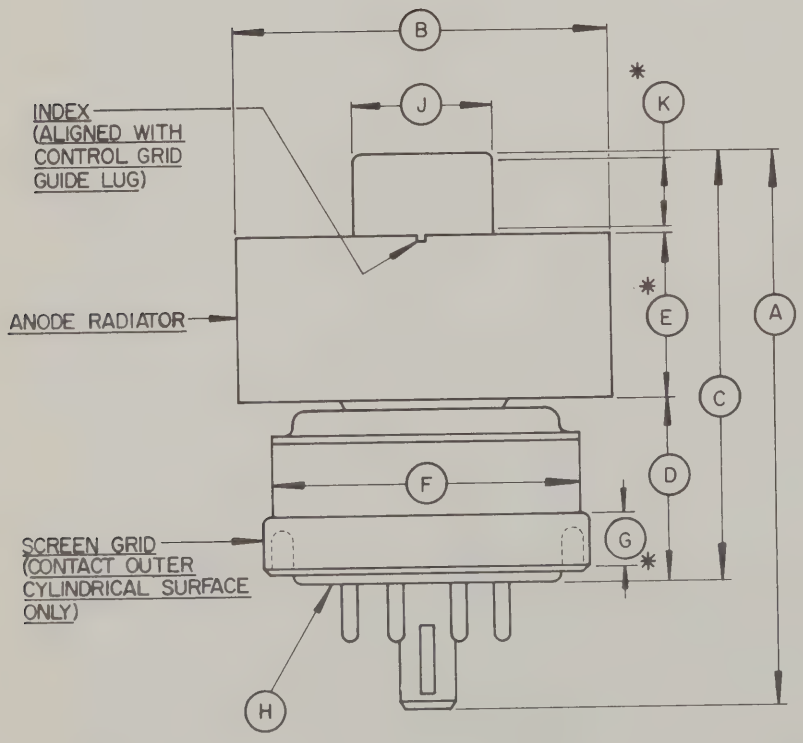

TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (V)
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.400
.200
.300
.100
.050
.200
.100
.050
.025
.010
.005
0
0


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 350V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (V)
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
.400
.300
.200
.200
.100
.050
.100
.050
.025
.050
0
.010
.025
.025
1.40
1.20
1.00
.800
.600
.010
.400
.200
.100
.050
0
.010
0

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.342	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--

PIN DESIGNATION

PIN NO. 1 SCREEN GRID
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. DO NOT USE FOR EXTERNAL CONNECTION.
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN-CONTROL GRID



NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.

TECHNICAL DATA

8957
4CX250BC

RADIAL-BEAM
POWER TETRODE

The 8957/4CX250BC is a ceramic/metal, forced-air cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 250 watts and a maximum input power rating of 500 watts. It is intended for use as an oscillator, amplifier, or modulator.

The 8957/4CX250BC is especially recommended as a premium-quality replacement for the 7203/4CX250B, in applications where long life and consistent performance are of prime concern and the closer heater voltage tolerance and increased cathode warmup time are acceptable.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.4	A
Cathode-Heater Potential, maximum	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (grounded cathode) [2]		
Cin	15.7	pF
Cout	4.5	pF
Cgp	0.04	pF
Direct Interelectrode Capacitances (grounded grid and screen) [2]		
Cin	13.0	pF
Cout	4.5	pF
Cpk	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:		
Length	2.46 in; 62.5	mm
Diameter	1.64 in; 41.7	mm
Net Weight	4 oz; 113	gm
Operating Position	Any	

(Effective 1-1-74) © 1974 by Varian

Printed in U.S.A.

Maximum Operating Temperature:
- Ceramic/Metal Seals . . . . . 250°C
- Anode Core . . . . . 250°C

Cooling . . . . . Forced Air
Base . . . . . Special 9-pin JEDEC-B8-236
Recommended Socket . . . . . EIMAC SK-600 Series
Recommended Chimney . . . . . EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current [2]	18	16	13	mAdc
Two-Tone Screen Current [2]	8	5	3	mAdc
Single-Tone Grid Current [2]	0	0	0	mAdc
Peak rf Grid Voltage [2]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	5	4	4	mAdc
Peak rf Grid Voltage [2]	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)					500 MHz	
Plate Voltage	500	1000	1500	2000	2000	Vdc
Screen Voltage	250	250	250	250	300	Vdc
Grid Voltage	-90	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	250	mAdc [2]
Screen Current [1]	45	40	27	25	16	mAdc [2]
Grid Current [1]	35	31	28	26	25	mAdc
Peak rf Grid Voltage [1]	114	114	112	112	---	v
Measured Driving Power [1]	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Plate Output Power	70	190	280	390	300	W [2]
Heater Voltage	6.0	6.0	6.0	6.0	5.7	V

1. Approximate value.
2. Measured values for a typical cavity amplifier circuit.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[1]	165	WATTS
SCREEN DISSIPATION[2]	12	WATTS
GRID DISSIPATION[2]	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current[3]	37	30	27	mAdc
Grid Current[3]	15	14	14	mAdc
Peak rf Grid Voltage[3]	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	300	W
Plate Output Power	60	145	235	W

1. Corresponds to 250 watts at 100% sine-wave modulation.
2. Average, with or without modulation.
3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1/3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	26	22	16	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	w
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

2. Per tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data is obtained by direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In Class C service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.		Max.	
Heater: Current at 6.0 volts	2.2	---	2.7	A
Cathode Warmup Time, with Heater Voltage at 6.0 volts	60	---	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)				
Cin	14.2	---	17.2	pF
Cout	4.0	---	5.0	pF
Cgp	---	---	0.06	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

MOUNTING - The 4CX250BC may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals. SK-600 series Air Chimneys are also available.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 225°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop(In. of water)	Air Flow (CFM)	Pressure Drop(In. of water)
200	4.2	0.4	6.1	0.6
250	5.7	0.7	8.2	1.0

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - This tube is designed to provide reliable service under ordinary shock and vibration conditions, such as encountered in mobile installations. However, when severe shock, or high-level and high-frequency vibration are expected, it is suggested that the EIMAC 7580W/4CX250R be employed.

ELECTRICAL

HEATER - The nominal heater voltage for the 4CX250BC is 6.0 volts when the voltage regulation is held to ±5%, and operation at this voltage and regulation will provide good life and stable performance. Regulation to a tolerance better than ±5% normally will be beneficial as regards life expectancy, and if variation can be held to ±1%, then the voltage may be reduced to as low as 5.7 volts, for greatest life expectancy. When this is done, however, voltage should be set and monitored with a voltmeter of high accuracy, which should be of the true-rms responding type.

Cathode peak current capability is dependent on cathode temperature, which is controlled by the heater operating voltage. Individual testing of the 4CX250BC assures adequate emission characteristics for normal rf or audio applications with heater voltage as low as 5.7 volts. Operation with the voltage lower than 5.7 volts should not be attempted at frequencies below UHF or cathode damage may result.

For pulse service, the full nominal value of 6.0 volts should be used on the heater.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend on frequency and operating conditions. When the tube is driven to a maximum input as a Class C amplifier, the heater voltage should be reduced in general accordance with the table below:

	Volt. Reg. to ±5%	Volt. Reg. to ±1%
300 MHz or lower	6.00 V	5.70 V
301 to 400 MHz	5.85 V	5.60 V
401 to 500 MHz	5.70 V	5.50 V

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission current. The maximum rated dc input current (anode) is 200 mAdc for plate-modulated operation and 250 mAdc for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied. If reduced heater voltage is being used, with close voltage regulation, a warmup time of longer than 60 seconds should be allowed. If the 4CX250BC is used as a replacement for the 7203/4CX250B, adjustment of the warmup time-delay relay may be required, since some equipments designed for the 4CX250B used a time delay setting as short as 30 seconds.

Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts, regardless of the polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 25 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

This maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

It is a normal characteristic of most tetrodes for the screen current to reverse under certain operating conditions, producing a negative current indication on the screen milliammeter. Though there is considerably less likelihood of this happening with the 4CX250BC than with similar types, the screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode should be provided by a bleeder resistor or a suitable regulating device, arranged to pass a minimum of 5 milliamperes per connected screen.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube (s) in the event that one tube fails.

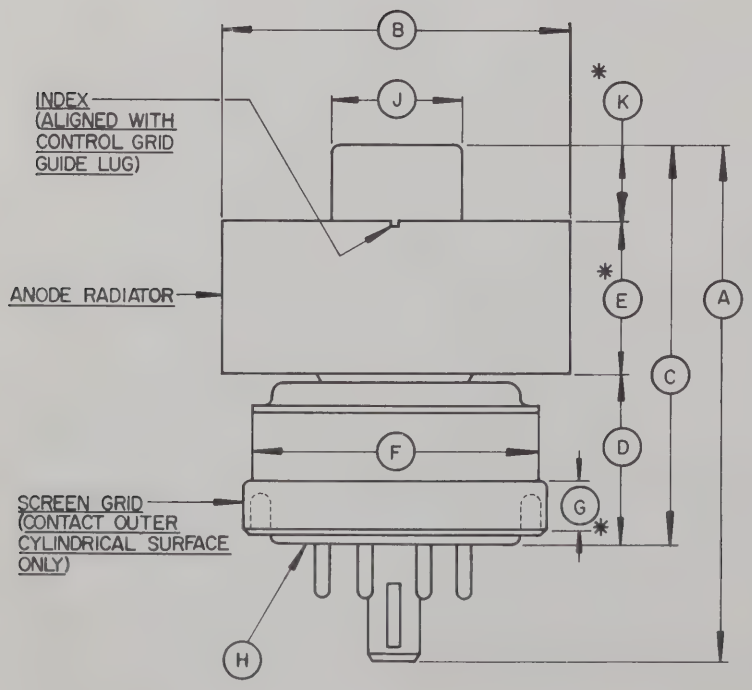
VHF OPERATION - The 4CX250BC is suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

HIGH VOLTAGE - Normal operating voltages used with the 4CX250BC are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.324	2464	- -	59.03	62.59	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	46.00	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: B8-236 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -

NOTES:
1. REF DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.

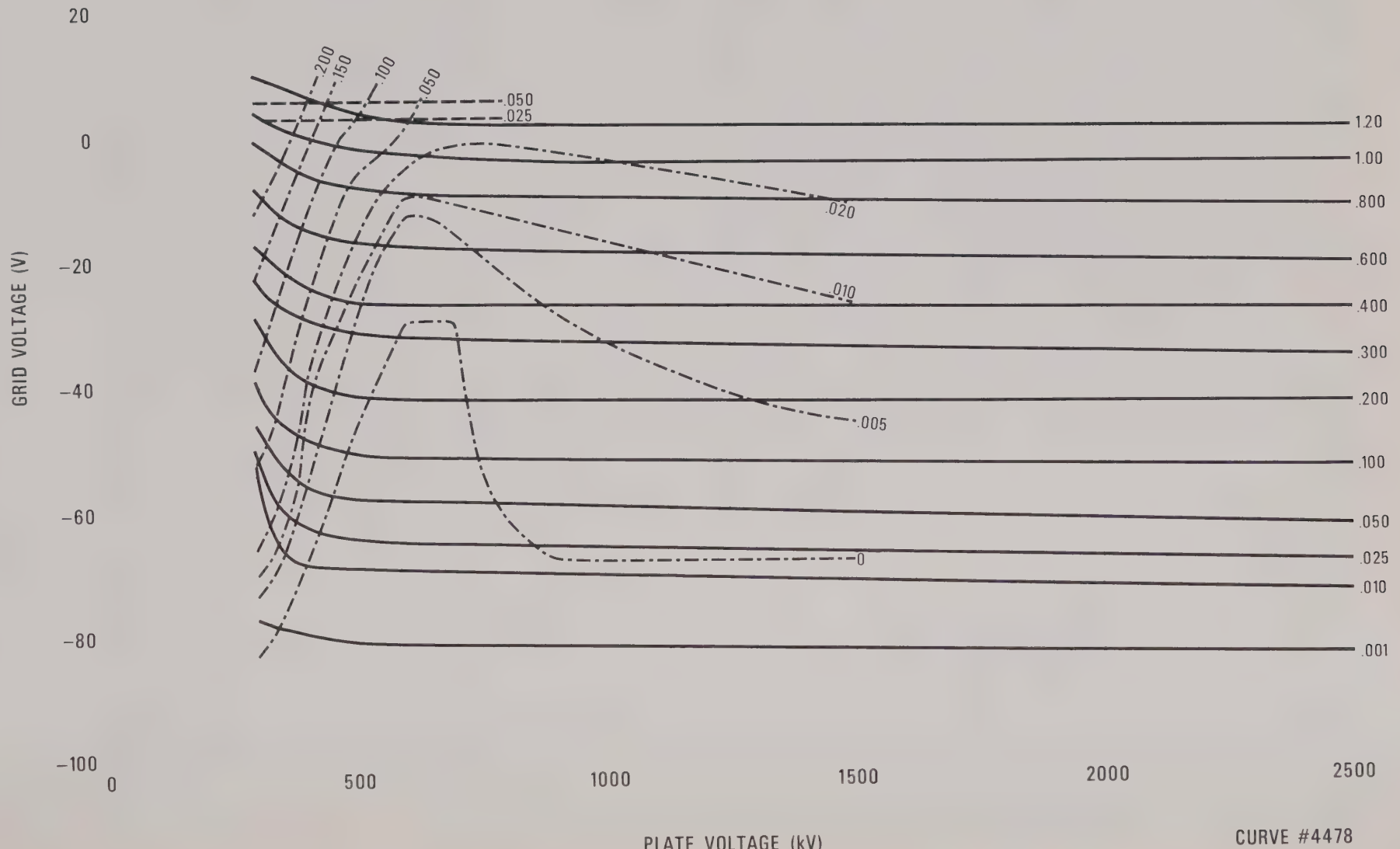
PIN DESIGNATION

PIN NO. 1	SCREEN GRID
PIN NO. 2	CATHODE
PIN NO. 3	HEATER
PIN NO. 4	CATHODE
PIN NO. 5	I.C. DO NOT USE FOR EXTERNAL CONNECTION.
PIN NO. 6	CATHODE
PIN NO. 7	HEATER
PIN NO. 8	CATHODE
CENTER PIN	CONTROL GRID

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE E_f = 6.0V SCREEN VOLTAGE = 350V

PLATE CURRENT – AMPERES — SCREEN CURRENT – AMPERES — GRID CURRENT – AMPERES

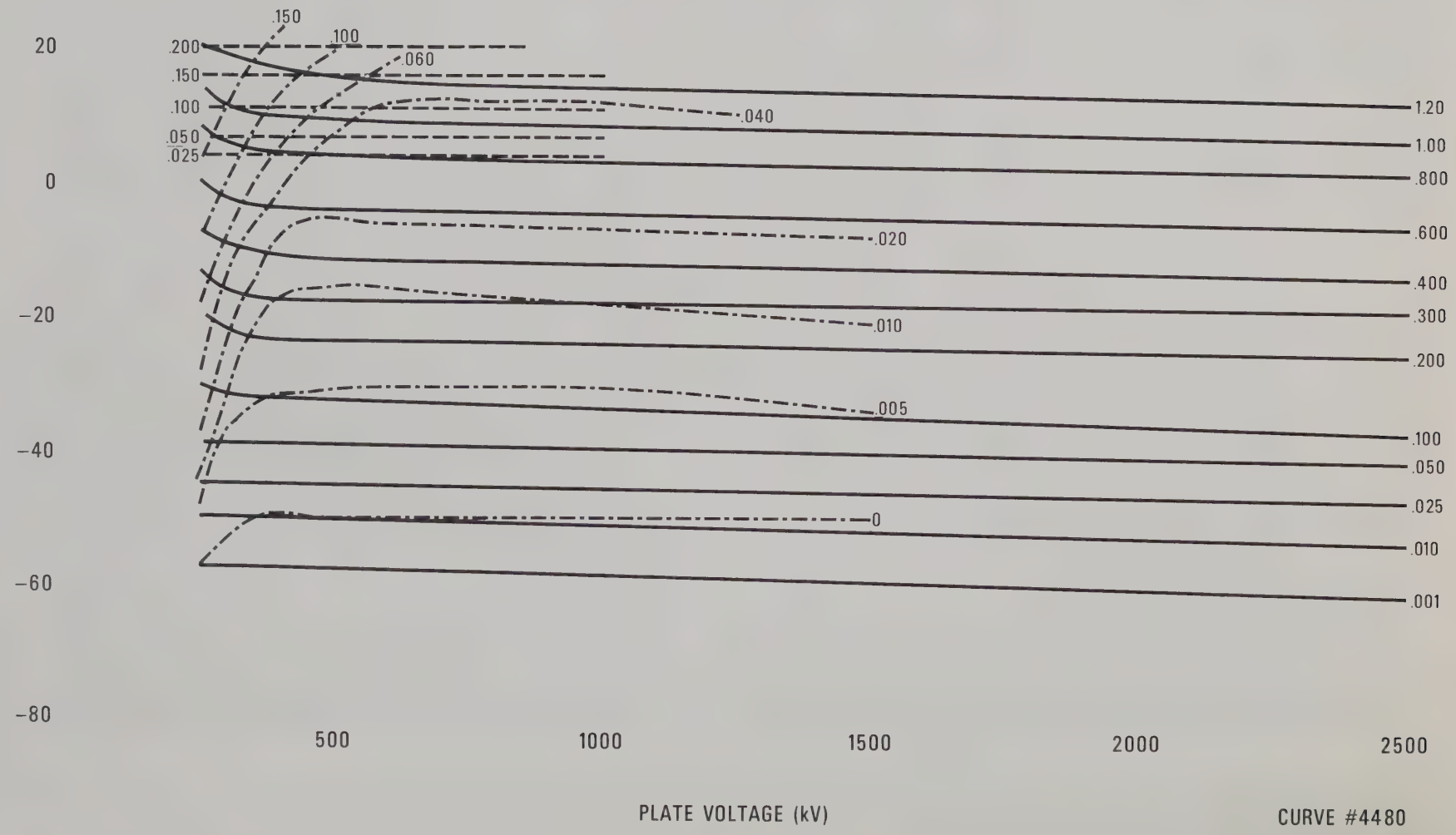


CURVE #4478

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE E_f = 6.0V SCREEN VOLTAGE = 250V

PLATE CURRENT – AMPERES — SCREEN CURRENT – AMPERES - - - GRID CURRENT – AMPERES



CURVE #4480

TECHNICAL DATA

7034
4X150A
7609

RADIAL-BEAM POWER TETRODE

The 7034/4X150A and 7609 are forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts up to 150 MHz, with reduced ratings applicable to 500 MHz. The 7034/4X150A is designed to operate with a heater voltage of 6.0 volts, while the 7609 is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage (7034)	6.0 ± 0.6	V
Current, at 6.0 volts	2.6	A
Cathode-Heater Potential	±150	V
Heater: Voltage (7609)	26.5 ± 2.6	V
Current at 26.5 volts	0.51	A
Cathode Heater Potential	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Input	15.7	pF
Output (7034)	4.5	pF
Output (7609)	4.2	pF
Feedback	0.03	pF
Frequency of Maximum Rating:	150	MHz
Highest Useful Frequency:	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the results of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.414 in; 61.32 mm
Diameter	1.640 in; 41.66 mm
Net Weight	4 oz; 113 gm
Operating Position	Any

(Revised 8-1-74) 1962, 1970, 1974 Varian Printed in U.S.A.

Maximum Operating Temperature: Glass Seals	200 °C
Ceramic Seals	250 °C
Anode Core	250 °C
Cooling	Forced Air
Base	Special 9-pin JEDEC-B8-236
Recommended Socket	EIMAC SK-600 Series
Recommended Chimney	EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)
Class AB1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [2]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current [3]	10	8	5	mAdc
Two-Tone Screen Current [3]	2	-1	-2	mAdc
Single-Tone Grid Current [3]	0	0	0	mAdc
Peak rf Grid Voltage [3]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	1750	3100	4750	Ω

2. Adjust to specified zero-signal dc plate current.
3. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)
Class AB1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [2]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage [3]	25	25	25	v
Plate Output Power	30	50	65	W

2. Adjust to specified zero-signal dc plate current.
3. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)					500 MHz [3]	
Plate Voltage	500	1000	1500	2000	1250	Vdc
Screen Voltage	250	250	250	250	250	Vdc
Grid Voltage	-90	-90	-90	-90	-80	Vdc
Plate Current	250	250	250	250	200	mAdc
Screen Current [2]	45	38	21	19	7	mAdc
Grid Current [2]	35	31	28	26	10	mAdc
Peak rf Grid Voltage [2]	114	114	112	112	---	v
Measured Driving Power [2]	4.0	3.5	3.2	2.9	10	W
Plate Input Power	125	250	375	500	250	W
Plate Output Power	70	190	280	390	140	W [2]
Heater Voltage	6.0	6.0	6.0	6.0	(4)	

2. Approximate value.
3. Measured values for a typical cavity amplifier circuit.
4. Heater voltage reduced to 5.5 volts and 24.3 volts for the 7034 and 7609 respectively.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE[1]	1600	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[2]	165	WATTS
SCREEN DISSIPATION[3]	12	WATTS
GRID DISSIPATION[3]	2	WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.
2. Corresponds to 250 watts at 100% sine-wave modulation.
3. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 150 MHz)

Plate Voltage	500	1000	1600	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current[4]	25	20	18	mAdc
Grid Current[4]	23	21	21	mAdc
Peak rf Grid Voltage[4]	173	172	172	v
Calculated Driving Power[4]	4.0	3.6	3.6	W
Plate Input Power	100	200	320	W
Plate Output Power	47	140	250	W

4. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1][3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (Plate to Plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max.	
Heater: 7034-Current at 6.0 volts	2.3	---	2.9	A
Heater: 7609-Current at 26.5 volts	0.40	---	0.62	A
Cathode Warmup Time	30	60	---	sec
Interelectrode Capacitances[1] (grounded cathode connection)				
Input	14.5	---	17.0	pF
Output (7034)	4.0	---	4.8	pF
Output (7609)	3.7	---	4.45	pF
Feedback	---	---	0.05	pF

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 7034 and 7609 may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation(watts)	Air Flow (CFM)	Pressure Drop(In. of water)	Air Flow (CFM)	Pressure Drop(In. of water)
200	5.2	0.58	7.8	0.85
250	6.1	0.79	9.0	1.10

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this is expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 7034 and 7609 is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency MHz	7034	7609
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.3 volts
401 to 500	5.50 volts	24.3 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for

amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 7034 or 7609.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

VHF OPERATION - The 7034 and 7609 are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

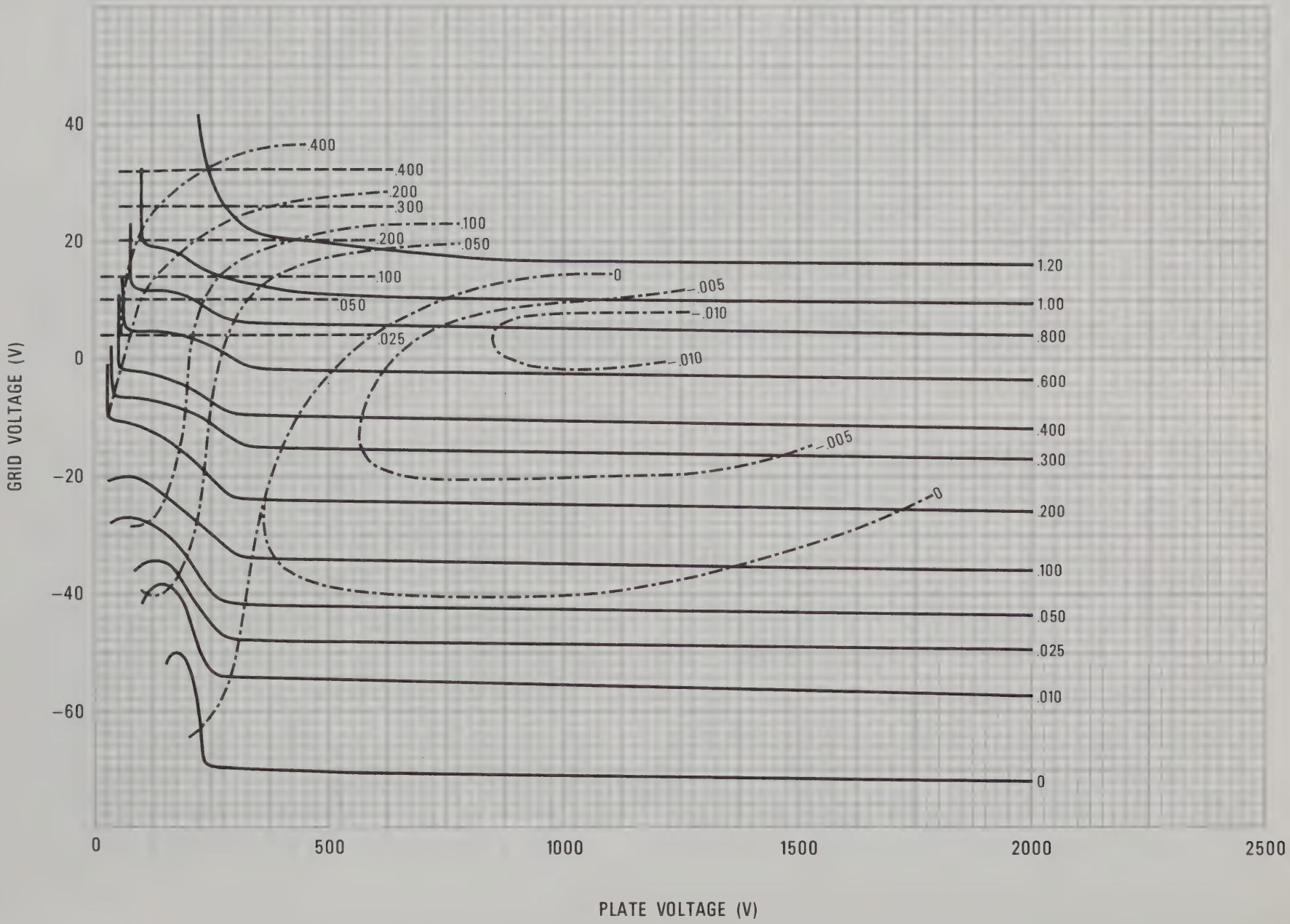
HIGH VOLTAGE - The 7034 and 7609 operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE = 250V

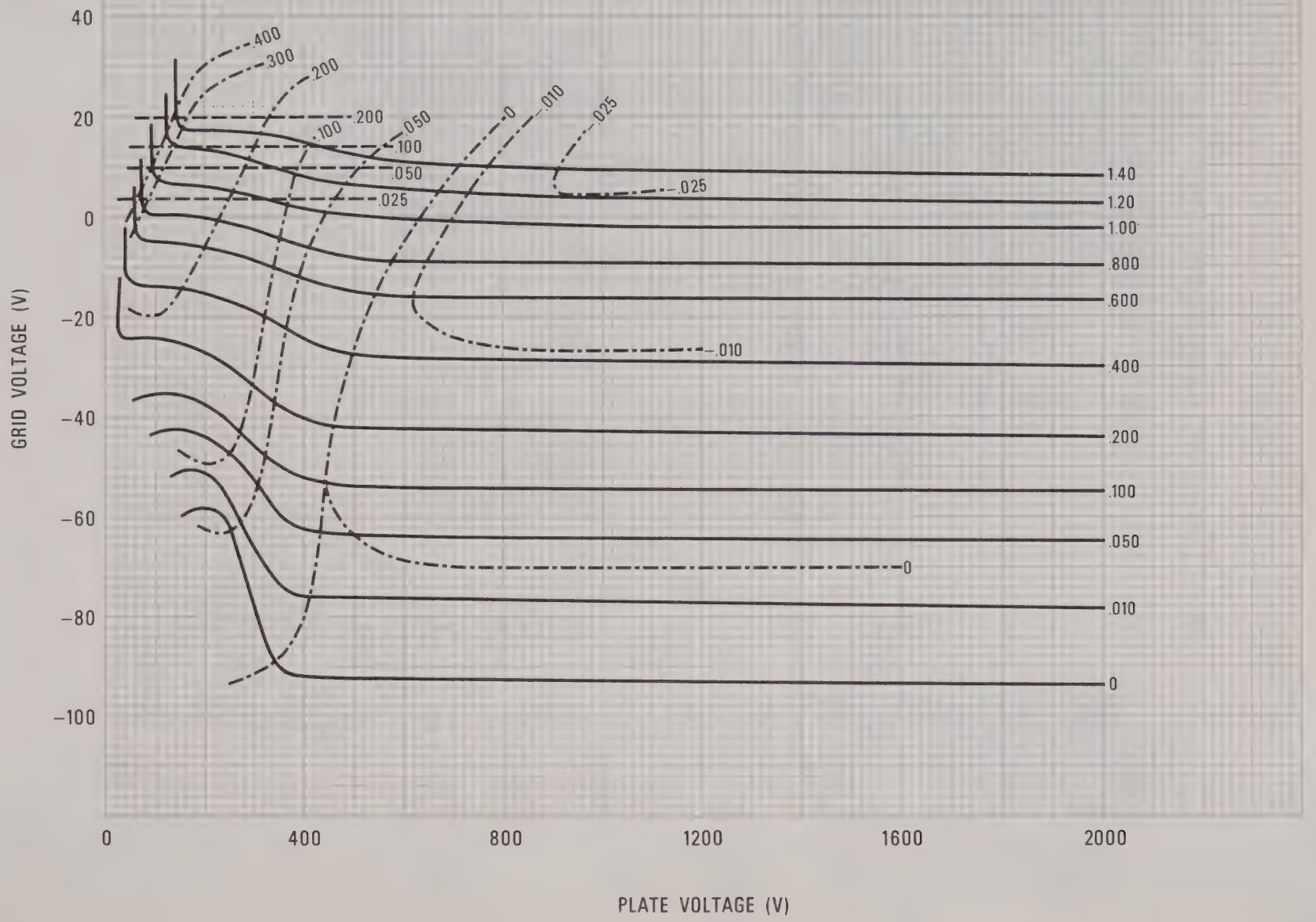
PLATE CURRENT – AMPERES SCREEN CURRENT – AMPERES GRID CURRENT – AMPERES

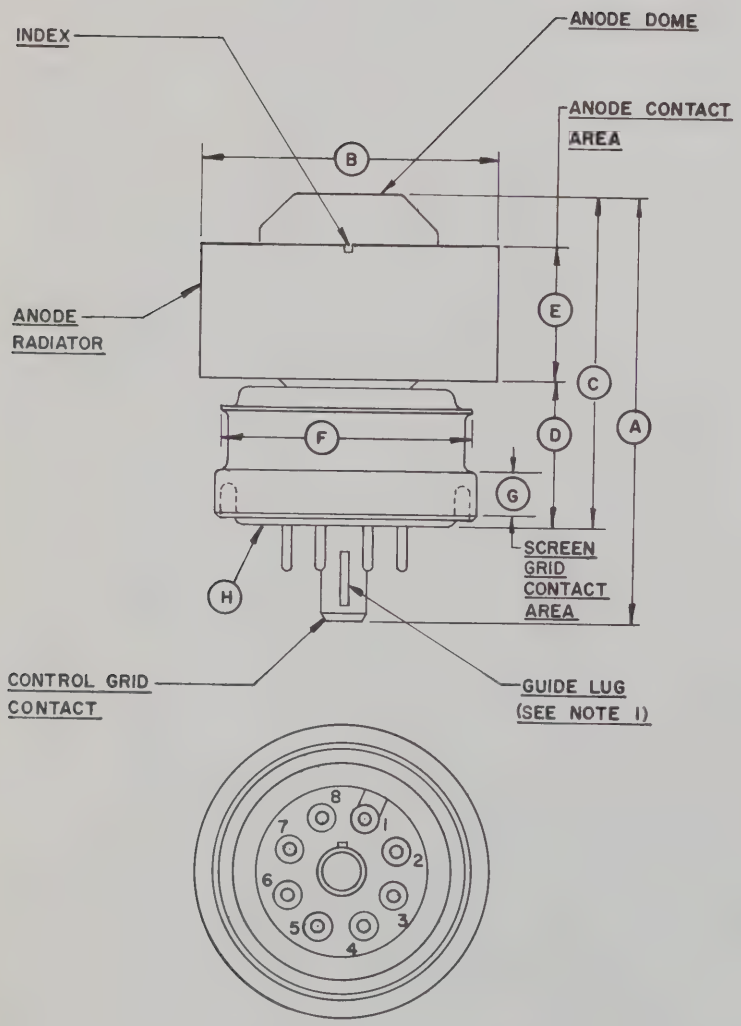


TYPICAL CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE = 350V

PLATE CURRENT – AMPERES — SCREEN CURRENT – AMPERES — GRID CURRENT – AMPERES





DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	NOM.	MIN.	MAX.	NOM.
A	2.224	2.414		59.03	62.59	
B	1.610	1.640		40.89	41.65	
C	1.710	1.860		43.43	47.24	
D	.750	.810		19.05	20.57	
E	.710	.790		18.03	20.07	
F		1.406			35.71	
G	.187			4.75		
H	BASE: B8-236 (JEDEC DESIGNATION)					

NOTES:

1. LOCATION OF GUIDE LUG OF CONTROL GRID CONTACT MAY BE REFERENCED BY AN ARROW OR NOTCH ON THE ANODE RADIATOR IN THE POSITION SHOWN.

PIN DATA

PIN NO. 1 SCREEN GRID
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C.—DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN—CONTROL GRID

8954

TECHNICAL DATA

VOLTAGE REGULATOR
OR SWITCH TUBE
POWER TETRODE

The EIMAC 8954 is designed for switch-tube (or modulator) and voltage regulator service, with anode current up to 8 amperes with short pulses (to 2 microseconds) and derated values of anode current at longer pulse lengths.

The tube has an oxide cathode and all electrical connections are made to solder tabs which are integral to the tube elements.

The 8954 is supplied bare-anode and is intended to be cooled by heat sink, or liquid immersion, or a combination, and is nominally rated for 600 watts of anode dissipation.

The tube is rated to operate at 5.5 kVdc in air, at sea level, or 7.5 kVdc in an insulating oil environment. The tube is designed to withstand brief fault conditions which may raise the instantaneous anode voltage to 12 kv.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater	6.0 V
Current	5.6 A
Cathode Heating Time (Minimum)	2.0 Min.
Direct Interelectrode Capacitance (Grounded Cathode)[2]	
Cin	50 pF
Cout	6.2 pF
Cgp	0.14 pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special, With Solder-Tab Terminals
Operating Position	Any
Maximum Operating Temperatures: Anode Core & Ceramic/Metal Seals	250°C
Cooling	Heat Sink/Liquid Immersion

(Effective 6-1-74) © 1974 by Varian Printed in U.S.A.

Maximum Overall Dimensions:

Length	2.52 In; 64.01 mm
Diameter	1.77 In; 44.96 mm
Net Weight	6.0 Oz; 170 gms

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 Volts	5.0	6.3	A
Cathode Warmup Time	120	---	Sec
Interelectrode Capacitances (grounded cathode circuit) [1]			
Cin	40.0	60.0	pF
Cout	5.2	7.2	pF
Cgp	----	0.15	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

PULSE MODULATOR OR SWITCH TUBE SERVICE

ABSOLUTE MAXIMUM RATINGS:

	In Air	In Oil	
HEATER VOLTAGE	6.0±5%	6.0±5%	VOLTS
DC PLATE VOLTAGE	5.5	7.5	KILOVOLTS
PEAK POSITIVE PLATE VOLTAGE	12	12	KILOVOLTS
DC SCREEN VOLTAGE	800	800	VOLTS
DC GRID VOLTAGE	-200	-200	VOLTS

	In Air	In Oil	
PEAK PLATE CURRENT [1]	8.0	8.0	AMPERES
PULSE LENGTH AND DUTY [1]	See Derating Chart		
PLATE DISSIPATION [2]	600	600	WATTS
SCREEN DISSIPATION	15	15	WATTS
GRID DISSIPATION	4	4	WATTS

1. Pulse length, peak current, and duty are inter-related. See DERATING CHART.
2. 600 W nominal; capability is dependent on cooling technique and design.

APPLICATION

MECHANICAL

MOUNTING - The 8954 may be operated in any position, with mounting normally controlled by the anode heat-sink configuration and location. No socket is required since all electrical connections are made to solder tabs which are integral to the tube elements.

COOLING - The tube is designed for use in a conduction-cooled or liquid-immersion-cooled system, where tube anode heat is transferred to a heat sink or the liquid dielectric coolant. Anode dissipation is normally limited only by the allowable temperature rise for the anode ceramic/metal seal and the anode core. In all cases, however, the cooling system must maintain the anode and ceramic/metal seal temperatures below 250°C, and in cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

In an air mounted heat-sink system, intimacy of contact between the anode surface and the sink is a factor which will effect heat transfer, and the designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized. In such a system, some air circulation around the base of the tube may also be required to maintain these ceramic/metal seals and the connection points at the solder tabs within the allowable temperature range.

ELECTRICAL

HEATER/CATHODE OPERATION - The rated heater voltage for the 8954 is 6.0 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long life and consistent performance. One side of the heater is internally connected to the cathode. Heater voltage should be applied for a minimum of two minutes before high voltage is applied to the other tube elements, to allow the cathode to reach operating temperature.

ANODE CURRENT - For pulse service, either as a switch tube or modulator, or for voltage regulator applications, an anode current (during the

pulse) of 8 amperes is available with short pulses (up to 2 μs). Peak current capability, pulse length, and duty factor are inter-related and for pulse durations longer than 2 μs the DERATING CHART should be consulted. For very long pulses (1 millisecond or longer) or pure dc service, the anode current should be limited to 0.6 ampere.

HIGH VOLTAGE - For air operation, anode voltage should not exceed 5.5 kVdc at sea level. This value allows some safety factor, but at higher altitudes a reduction in voltage may be required to preclude the possibility of external tube flash-over, and the external insulating surfaces of the tube must be kept clean and free of dirt or any accumulation of grime to minimize the possibility of external breakdown. When the tube is immersed in a liquid dielectric coolant with suitable insulating properties, the allowable anode voltage is 7.5 kVdc at any altitude.

The operating voltages for this tube must be considered as potentially lethal and the equipment must be designed properly and operating precautions must be followed. The equipment must include safety enclosures for the high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors or covers are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL .

PLATE SURGE-LIMITING IMPEDANCE - Beam-power tetrodes, such as the 8954, are built with closely spaced electrodes. This results in high voltage gradients even at normal operating voltages. A high-energy arcover between electrodes may be destructive, and therefore a series impedance in the anode lead is recommended, or the anode supply should be designed so that it has sufficient self impedance, to limit the short-circuit current to 10 times the maximum pulse-current rating. Normal overload protection techniques should also be used, not only in the anode circuit but also in the screen grid circuit, to prevent tube damage in the event of a fault condition.

GRID OPERATION - The maximum rated dc grid bias voltage is -200 Vdc and the maximum grid dissipation rating is 4 watts. In normal applications the grid dissipation will not approach the maximum rating.

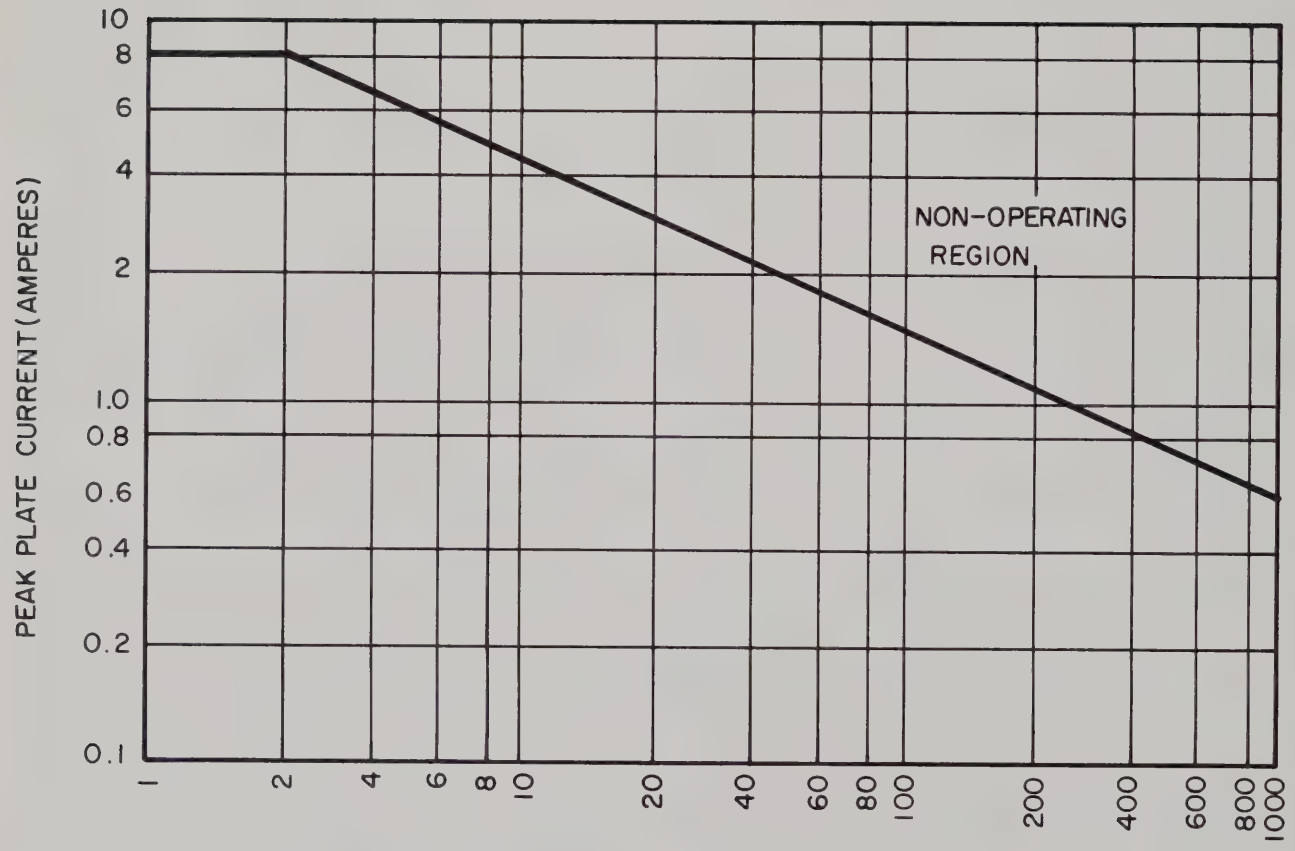
SCREEN OPERATION - The maximum rated power dissipation for the screen grid is 15 watts, and the average screen input power should be kept below this level.

It is a normal characteristic of most tetrodes for the screen current to instantaneously reverse with some combinations of element voltages and currents. The screen power supply should be designed with this in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

Over-current protection should be provided for the screen and it may be desirable to interlock the screen power supply so that plate voltage must be on before screen voltage can be applied.

PLATE OPERATION - The anode of the 8954 is nominally rated for 600 watts of dissipation capability. This capability is dependent on a properly designed heat sink, or the use of liquid-immersion cooling with a dielectric fluid of suitable characteristics, or a combination of both. Average anode dissipation may be calculated as the product of pulse anode current, pulse tube-voltage drop during conduction, and the duty factor. Actual dissipation may often exceed the calculated value if pulse rise and fall times are appreciable compared to pulse duration. This occurs because long rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high tube-voltage-drop region.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to: Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

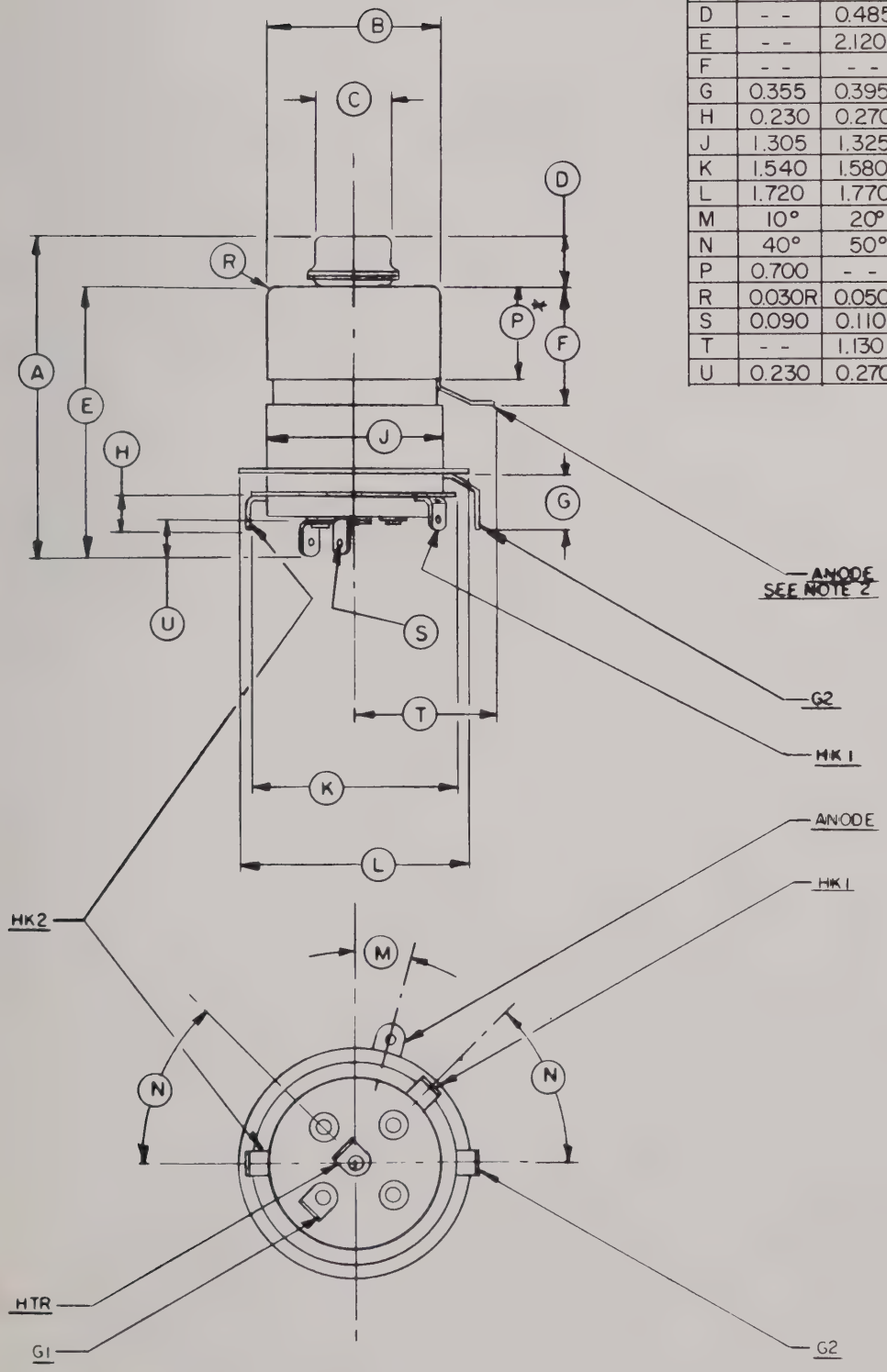


PEAK (PULSE) PLATE CURRENT CAPABILITY IS DEPENDENT ON PULSE DURATION (tp) AND DUTY FACTOR (Du). MAXIMUM PEAK PLATE CURRENT FOR A GIVEN PULSE DURATION IS SHOWN. MAXIMUM DUTY MAY THEN BE DERIVED FROM THE RELATIONSHIP:

$$0.6 = ib\sqrt{Du}$$

PULSE DE-RATING DATA, TYPE 8954

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	2.500	- -	- -	63.50
B	1.298	1.302	- -	32.96	33.07	- -
C	0.559	0.573	- -	14.19	14.55	- -
D	- -	0.485	- -	- -	12.31	- -
E	- -	2.120	- -	- -	53.84	- -
F	- -	- -	0.887	- -	- -	22.52
G	0.355	0.395	- -	9.01	10.03	- -
H	0.230	0.270	- -	5.84	6.85	- -
J	1.305	1.325	- -	33.14	33.65	- -
K	1.540	1.580	- -	39.11	40.13	- -
L	1.720	1.770	- -	43.68	44.95	- -
M	10°	20°	- -	10°	20°	- -
N	40°	50°	- -	40°	50°	- -
P	0.700	- -	- -	17.78	- -	- -
R	0.030R	0.050R	- -	0.76R	1.27R	- -
S	0.090	0.110	- -	2.28	2.79	- -
T	- -	1.130	- -	- -	28.70	- -
U	0.230	0.270	- -	5.84	6.85	- -



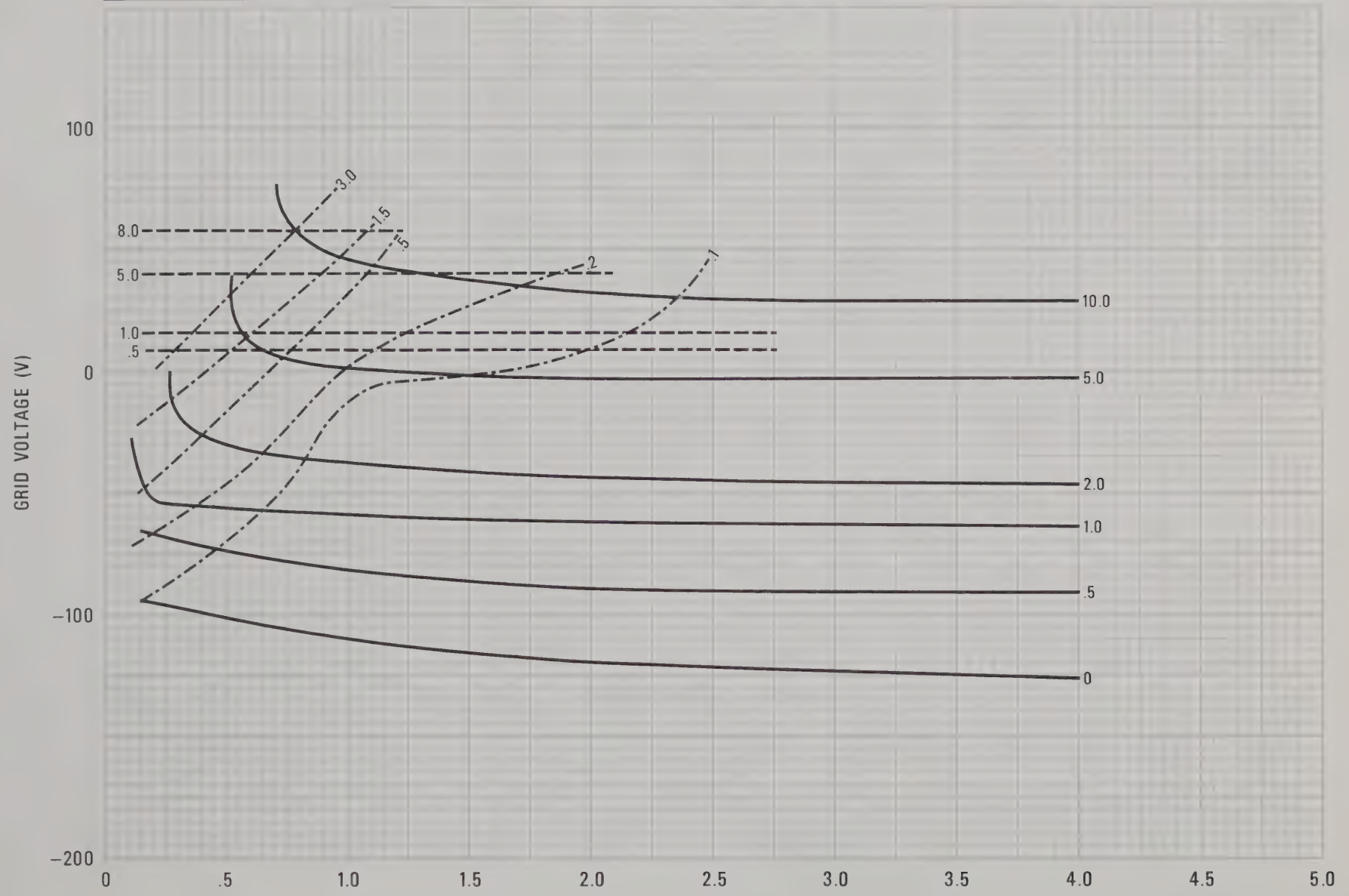
NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. ANODE TAB IS ROTATED 75°. SEE BOTTOM VIEW FOR TAB ORIENTATION.
3. (*) CONTACT SURFACE.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE E_f = 6.0V SCREEN VOLTAGE = 600V

PLATE CURRENT – AMPERES — SCREEN CURRENT – AMPERES — GRID CURRENT – AMPERES

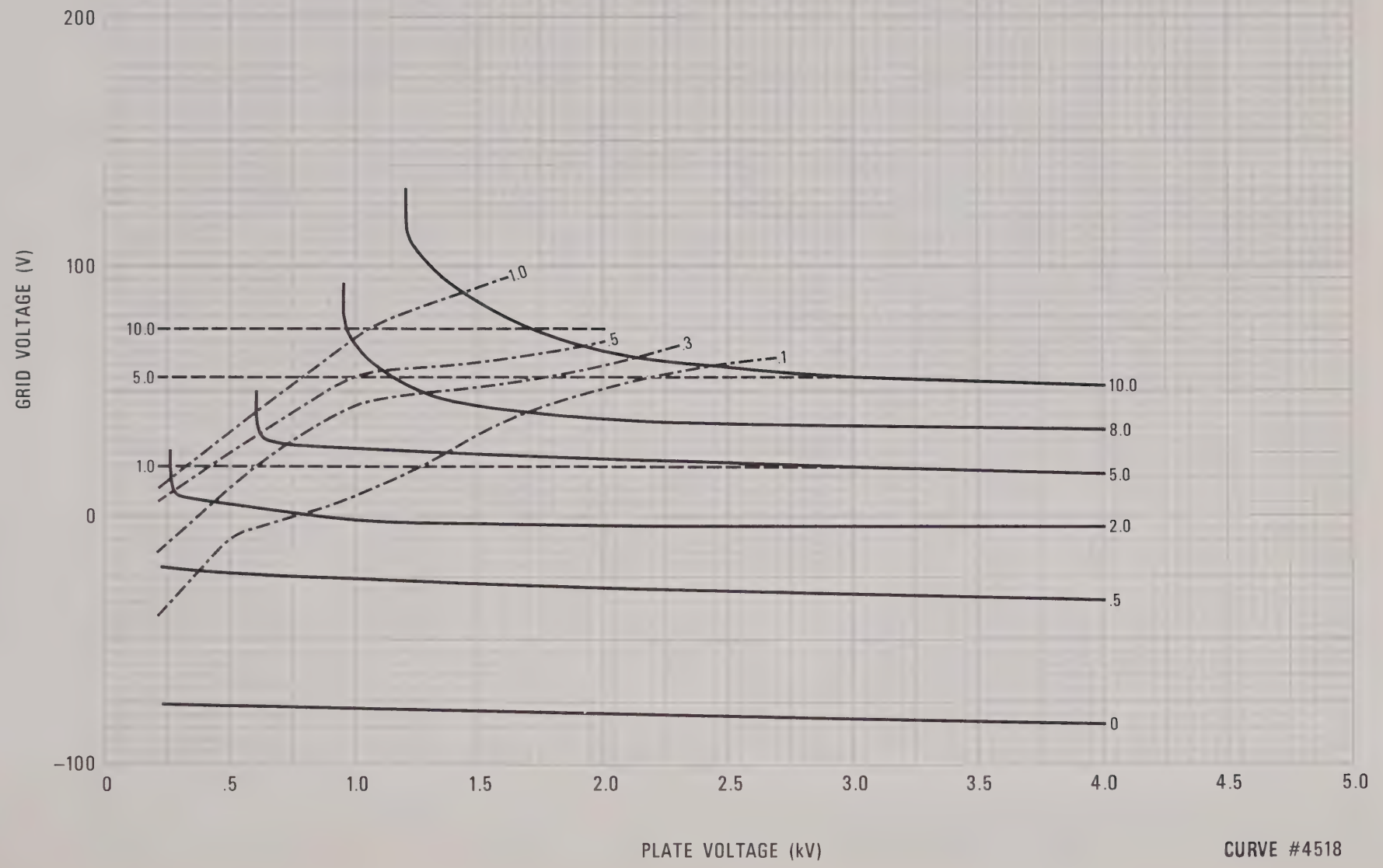


CURVE #4516

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE E_f = 6.0V SCREEN VOLTAGE = 400V

——— PLATE CURRENT – AMPERES -·-·- SCREEN CURRENT – AMPERES – – – – GRID CURRENT – AMPERES



CURVE #4518

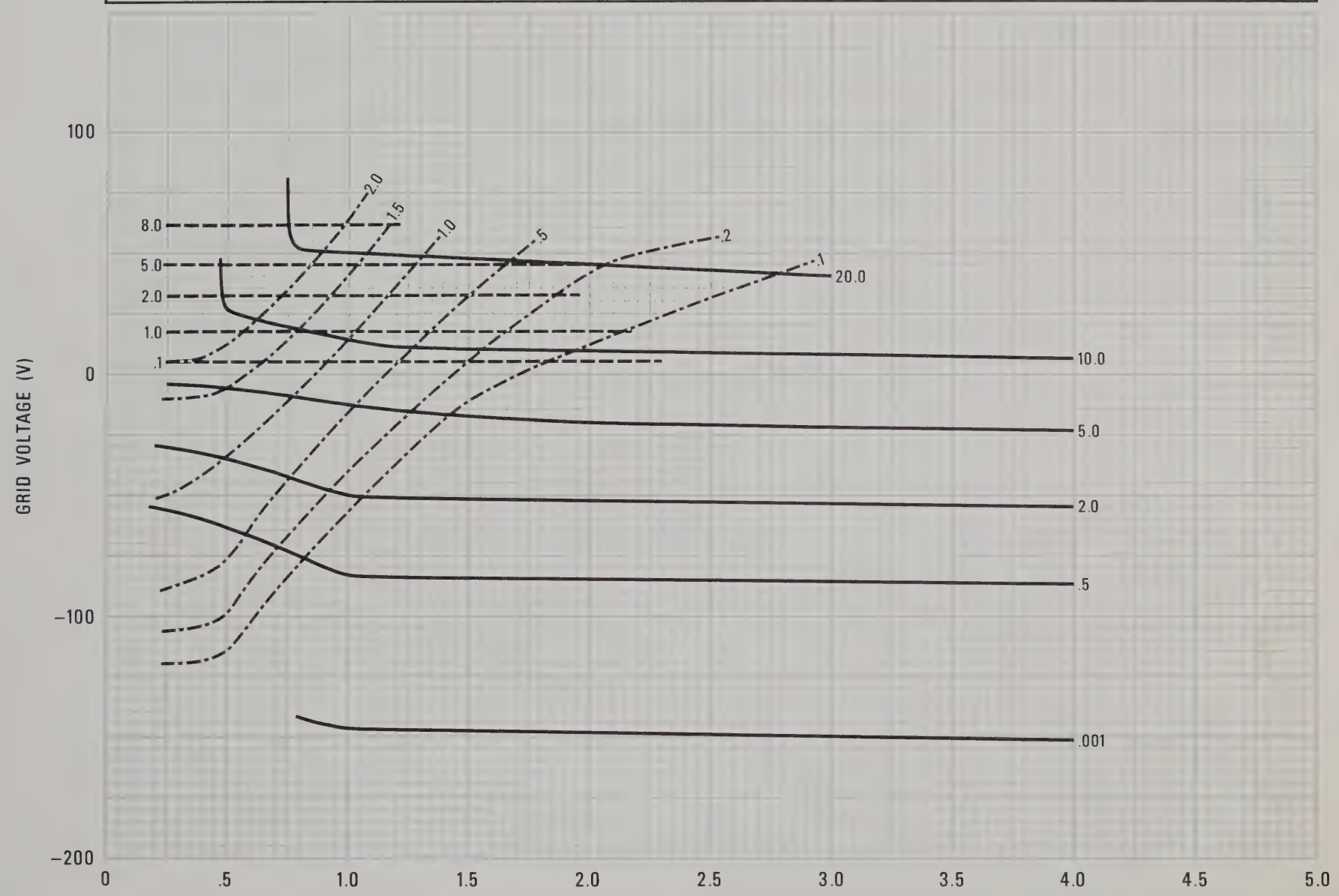
8954

Eimac

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE E_f = 6.0V SCREEN VOLTAGE = 800V

PLATE CURRENT – AMPERES SCREEN CURRENT – AMPERES GRID CURRENT – AMPERES



CURVE #4526

8959

HIGH-POWER
WATER-COOLED
TETRODE

TECHNICAL DATA



The EIMAC 8959 is a ceramic/metal high power tetrode for applications requiring tube outputs from 100 to 250 kilowatts. It is ideal for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier, or a Class AB push-pull audio amplifier or modulator, as well as a plate and screen modulated Class C rf amplifier.

In pulse modulator service it can deliver a peak output of 4 megawatts.

The tube is characterized by low input and feedback capacitances and low internal lead inductances. Its rugged mesh thoriated tungsten filament provides ample emission for long operating life.

The water-cooled anode dissipates 100 kilowatts when used with an EIMAC SK-2100 series water jacket.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten Mesh	
Voltage	15.5 ± 0.75 V
Current, @ 15.5 V	215 A
Direct Interelectrode Capacitances (Grounded Cathode)	
Cin	370 pF
Cout	60 pF
Cgp	1.0 pF
Direct Interelectrode Capacitances (Grounded Grid)	
Cin	175 pF
Cout	60 pF
Cpk	0.35 pF
Frequency of Maximum Rating, CW	108 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions	See Outline Drawing
Net Weight (approximate): Tube Only	38.5 lb; 17.5 kg
Tube and Water Jacket SK-2110	47.0 lb; 21.4 kg
Operating Position	Vertical, base up or down
Anode Cooling (EIMAC SK-2100 series water jacket required, to be ordered separately)	Water
Base Cooling	Forced Air

(Effective 11-1-74) © 1974 Varian

Printed in U.S.A.

Maximum Operating Temperature: Ceramic/Metal Seals and Envelope . . . . . 250°C
Recommended Air-System Socket . . . . . EIMAC SK-2000 Series
Base . . . . . Special Coaxial

RADIO FREQUENCY LINEAR AMPLIFIER

Class AB, Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC PLATE CURRENT	16 AMPERES
PLATE DISSIPATION	100 KILOWATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
Class AB_1, Grid Driven
Peak Envelope or Modulation Crest Conditions

Plate Voltage	18 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage [1]	-320 Vdc
Zero-Signal Plate Current	4.0 Adc
Single-Tone Plate Current	13.5 Adc
Peak rf Grid Voltage [2]	300 v
Plate Dissipation [2]	75 kW
Plate Output Power [2]	168 kW
Resonant Load Impedance	697 Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR - Class C Telegraphy or FM

(Key-down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC PLATE CURRENT	16 AMPERES
PLATE DISSIPATION	100 KILOWATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

1. Approximate value

TYPICAL OPERATION

Plate Voltage	20 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage	-800 Vdc
Plate Current	15.2 Adc
Screen Current [1]	570 mAdc
Grid Current [1]	125 mAdc
Peak rf Grid Voltage [1]	900 v
Driving Power (calculated)	120 W
Plate Dissipation [1]	54 kW
Plate Output Power [1]	220 kW
Resonant Load Impedance	575 Ω

PLATE MODULATED RADIO FREQUENCY AMPLIFIER, GRID DRIVEN

Class C Telephony - Carrier Conditions

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	17.5 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC PLATE CURRENT	16 AMPERES
PLATE DISSIPATION [2]	67 KILOWATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.
2. Corresponds to 100 kW at 100% sine-wave modulation.

TYPICAL OPERATION

Plate Voltage	15 kVdc
Screen Voltage	750 Vdc
Grid Voltage	-600 Vdc
Plate Current	11.7 Adc
Screen Current [1]	875 mAdc
Grid Current [1]	660 mAdc
Peak Audio Screen Voltage for 100% Modulation	750 v
Peak rf Grid Voltage [1]	800 v
Driving Power (calculated)	530 W
Plate Dissipation [1]	35 kW
Plate Output Power [1]	140 kW
Resonant Load Impedance	620 Ω

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR, GRID DRIVEN

Class AB_1, Sinusoidal Wave

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC PLATE CURRENT	16 AMPERES
PLATE DISSIPATION	100 KILOWATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (2 Tubes)

Plate Voltage	15 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage [1]	-345 Vdc
Zero-Signal Plate Current	6.0 Adc
Max. Signal Plate Current	19.5 Adc
Max. Signal Screen Current [2]	830 mAdc
Peak Audio Grid Voltage/Tube [2]	275 v
Max. Signal Plate Diss./Tube [2]	46 kW
Plate Output Power [2]	200 kW
Load Resistance, plate/plate	1825 Ω

PULSE MODULATOR SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	40	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC GRID VOLTAGE	-2.0	KILOVOLTS
PEAK CATHODE CURRENT	200	AMPERES
PLATE DISSIPATION [1] (DURING PULSE)	1.0	MEGAWATT
PLATE DISSIPATION (AVERAGE)	100	KILOWATTS
SCREEN DISSIPATION (AVERAGE)	1750	WATTS
GRID DISSIPATION (AVERAGE)	500	WATTS
PULSE LENGTH	10	MILLISECONDS

TYPICAL OPERATION

Plate Voltage	40	kVdc
Plate Current, pulse	110	a
Screen Voltage	2.5	kVdc
Screen Current, pulse [2]	12	a
Grid Voltage	-1.2	kVdc
Grid Current, pulse [2]	400	ma
Positive Grid Voltage, pulse [2]	110	v
Duty Factor	6	%
Output Voltage, pulse [2]	37	kv
Input Power, pulse	4.4	Mw
Output Power, pulse [2]	4.1	Mw
Cathode Current, pulse [2]	122	a

1. Power dissipated during rise and fall time neglected.
2. Approximate value.

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current, at 15.5 volts	200	230	A
Cutoff Bias, at E_b = 25 kVdc, E_{c2} = 1500 Vdc, I_b = 10 mAdc	---	-625	Vdc
Interelectrode Capacitances (measurement without shielded fixture)			
Grounded Cathode Connection:			
Cin	350	390	pF
Cout	55	65	pF
Cgp	---	1.2	pF
Grounded Grid Connection:			
Cin	160	190	pF
Cout	55	65	pF
Cpk	---	0.5	pF

APPLICATION

MOUNTING - The 8959 must be mounted with its major axis vertical. The tube base may be either up or down, at the discretion of the circuit designer.

SOCKETING - An EIMAC SK-2000 Series Socket, or equivalent, is recommended.

ANODE WATER JACKET - An EIMAC SK-2100 or SK-2110 Water Jacket must be used to provide anode cooling. To achieve an anode dissipation of 100 kilowatts, the water jacket must be installed over the tube anode and adequate water flow provided.

COOLING - Anode cooling is accomplished by circulating water through an SK-2100 series Water Jacket. Insufficient water flow will cause the anode temperature to rise to levels which will shorten tube life. Also, if the coolant lines become clogged, enough steam pressure may be generated to rupture the water jacket and destroy the tube. The following table lists the minimum cooling water requirements at various dissipation levels with a maximum inlet water temperature of 50°C.

Anode Dissipation (kW)	Minimum Water Flow (gpm)	Approximate Pressure Drop (psi)
20	5.0	2.8
40	9.0	5.8
60	12.5	9.3
80	16.5	14.2
100	20.0	19.2

Note: Since the filament dissipates about 3500 watts, and the grid-plus-screen can, under some conditions, dissipate another 2250 watts, the table allows for an additional dissipation of 5750 watts.

Outlet water temperature must never exceed 70°C and inlet water pressure should be limited to 80 psi. Direction of water flow is optional.

Tube life can be seriously affected by the condition of the cooling water. If it becomes ionized, copper-oxide deposits form on the inside of the water jacket causing localized anode heating and eventual tube failure.

To insure minimum electrolysis, and power loss, the water resistance at 20°C should be greater than 50,000 ohms/cm^3, preferably 250,000 ohms/cm^3 or higher. The relative water resistance can be continuously monitored by measuring the leakage current through a short section of the insulating hose, using metal nipples or fittings as electrodes.

Auxiliary forced-air cooling, of the tube base is required to maintain filament- and grid-seal temperatures below 250°C. An air flow of approximately 120 ft^3/min at 50°C maximum and sea level should be directed, through an EIMAC SK-2000 Series Socket or equivalent, toward the filament- and grid-seal areas.

Both anode and base cooling should be applied before or simultaneously with the application of electrode voltages, including the filament. Base cooling should continue for about three minutes after the removal of electrode voltages to allow the tube to cool properly.

FILAMENT OPERATION - At rated filament voltage, the peak emission of the 8959 is many times greater than the amount needed for communication service. Reducing the filament voltage decreases the filament temperature. A small decrease in filament temperature substantially increases filament life. The correct value of filament-voltage should be determined for the particular applications. First, gradually reduce the filament voltage to the point where there is a noticeable reduction in plate current or power output, or an increase in distortion. Then increase the voltage several tenths of a volt above the value where performance degradation occurred; this is the proper operating voltage. Filament voltage should always be measured at the tube base or socket using an rms responding meter. The above procedure should be performed periodically to assure optimum tube life.

GRID OPERATION - The maximum control-grid dissipation is 500 watts, determined approximately by the product of grid current and peak positive grid voltage.

Under some operating conditions, the control grid may exhibit a negative-resistance characteristic. This may occur when, with high screen-grid voltage, increasing the drive voltage decreases the grid current. As a result, large values of instantaneous negative grid current can be produced, causing the amplifier to become regenerative. Because this may happen, the driver stage must be designed to tolerate this condition. One technique is to swamp the driver so that the change in load, due to secondary grid emission, is a small percentage of the total driver load.

SCREEN OPERATION - The maximum screen-grid dissipation is 1750 watts. With no ac applied to the screen, dissipation is simply the product of dc screen voltage and dc screen current. With screen modulation, dissipation is dependent on rms screen voltage and rms screen current.

Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since the screen dissipation rating will be exceeded. Suitable protective circuitry should be provided.

The 8959 may exhibit reverse screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. A bleeder resistor must be used if a series electron-tube regulator is employed.

PLATE DISSIPATION - The rated plate dissipation of 100 kilowatts, attainable with water cooling, provides a large margin of safety in most applications. This rating may be exceeded briefly during tuning. When the 8959 is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions should be limited to 67 kilowatts.

FAULT PROTECTION - In addition to the normal plate-overcurrent interlock, screen-current interlock, and coolant-flow interlock, it is good practice to protect the tube from internal damage caused by an internal plate arc which may occur at high plate voltages.

A protective resistance of 5 to 25 ohms should always be connected in series with each tube anode, to absorb power-supply stored energy if a plate arc should occur. An electronic crowbar, which will discharge power-supply capacitors in a few microseconds after the start of a plate arc, is recommended.

OPERATING HAZARDS

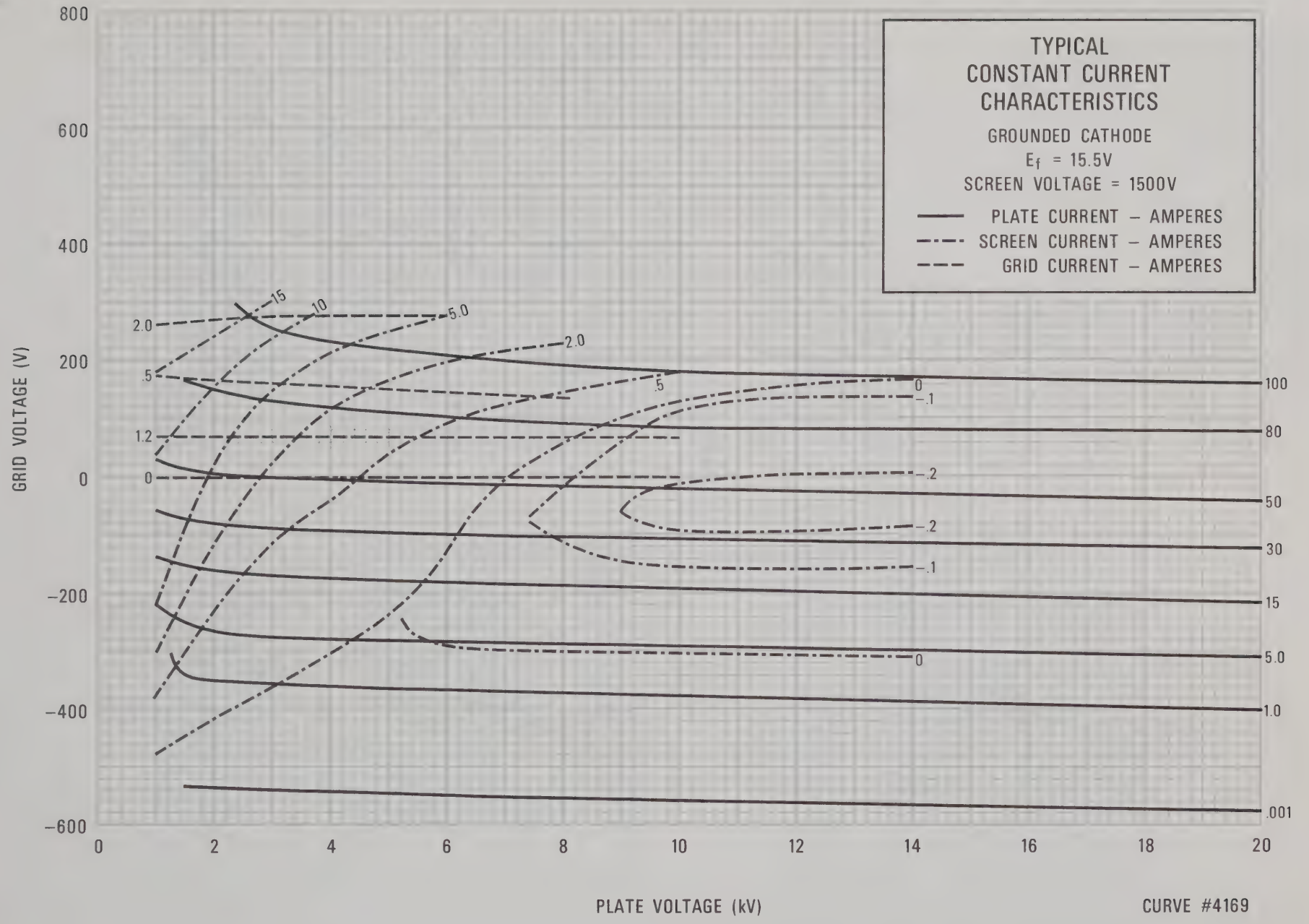
Read the following and take all necessary precautions to safeguard personnel. Safe operating conditions are the responsibility of the equipment designer and the user.

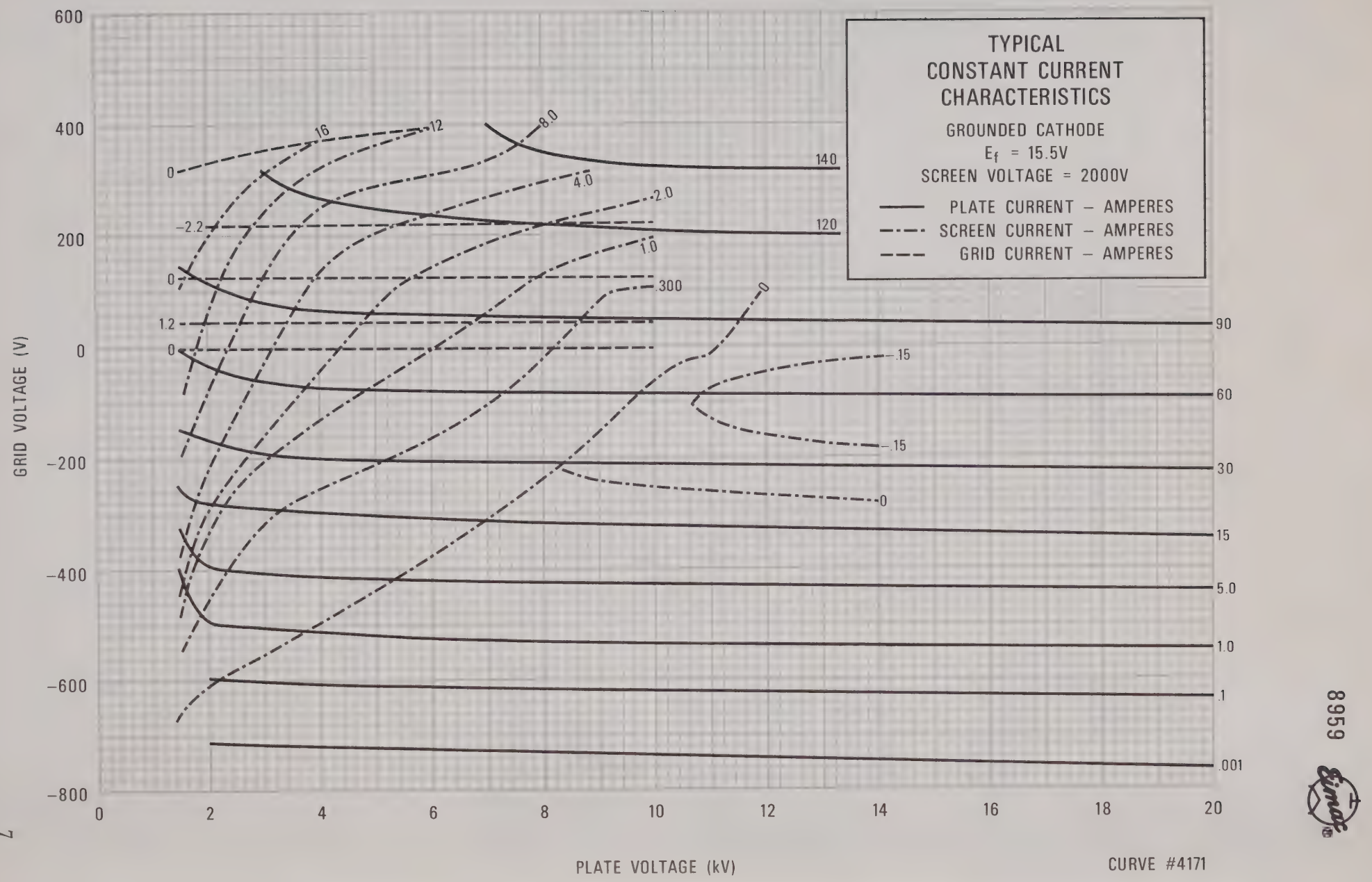
HIGH VOLTAGE - This tube operates at voltages which can be deadly. Equipment must be designed so personnel cannot come in contact with operating voltages. Enclose high-voltage circuits and terminals and provide fail-safe interlocking switch circuits to open the primary circuits of the power supply and to discharge high-voltage condensers whenever access into the enclosure is required.

X-RAY RADIATION - The EIMAC 8959, operating at its rated voltages and currents, is a potential X-ray hazard. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to changes in leakage paths or emission characteristics as they are affected by high voltage. Only limited shielding is afforded by the tube envelope. Additional X-ray shielding must be provided on all sides of the tube to provide adequate protection to operating personnel throughout the tube's life. When this tube is used as a pulse modulator, shielding of the pulse transformer may also be necessary. X-ray caution signs or labels must be permanently attached to equipment using this tube directing operating personnel never to operate this device without X-ray shielding in place.

RADIO FREQUENCY RADIATION - Exposure of the human body to rf radiation becomes increasingly more hazardous as the power level and/or frequency are increased. Exposure to high-power rf radiation must be strictly prevented at any frequency.

Equipment must be designed to fully safeguard all personnel from these hazards. Labels and caution notices must be provided on equipment and in manuals clearly warning of these hazards.

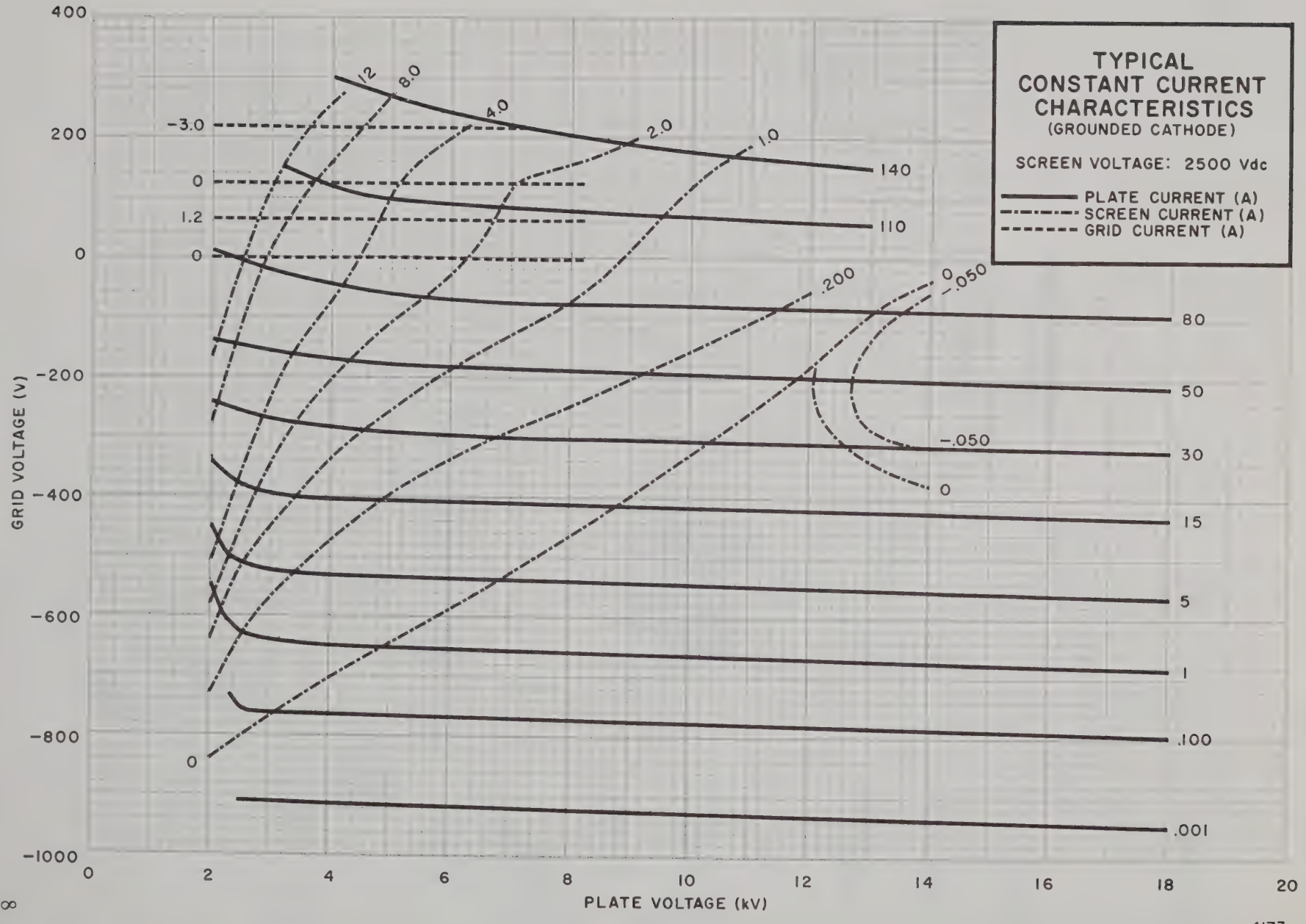

TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 15.5V
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
CURVE #4169
15
10
5.0
2.0
.5
1.2
0
2.0
.5
0
−.1
−.2
−.2
−.1
0
100
80
50
30
15
5.0
1.0
.001



CURVE #4171

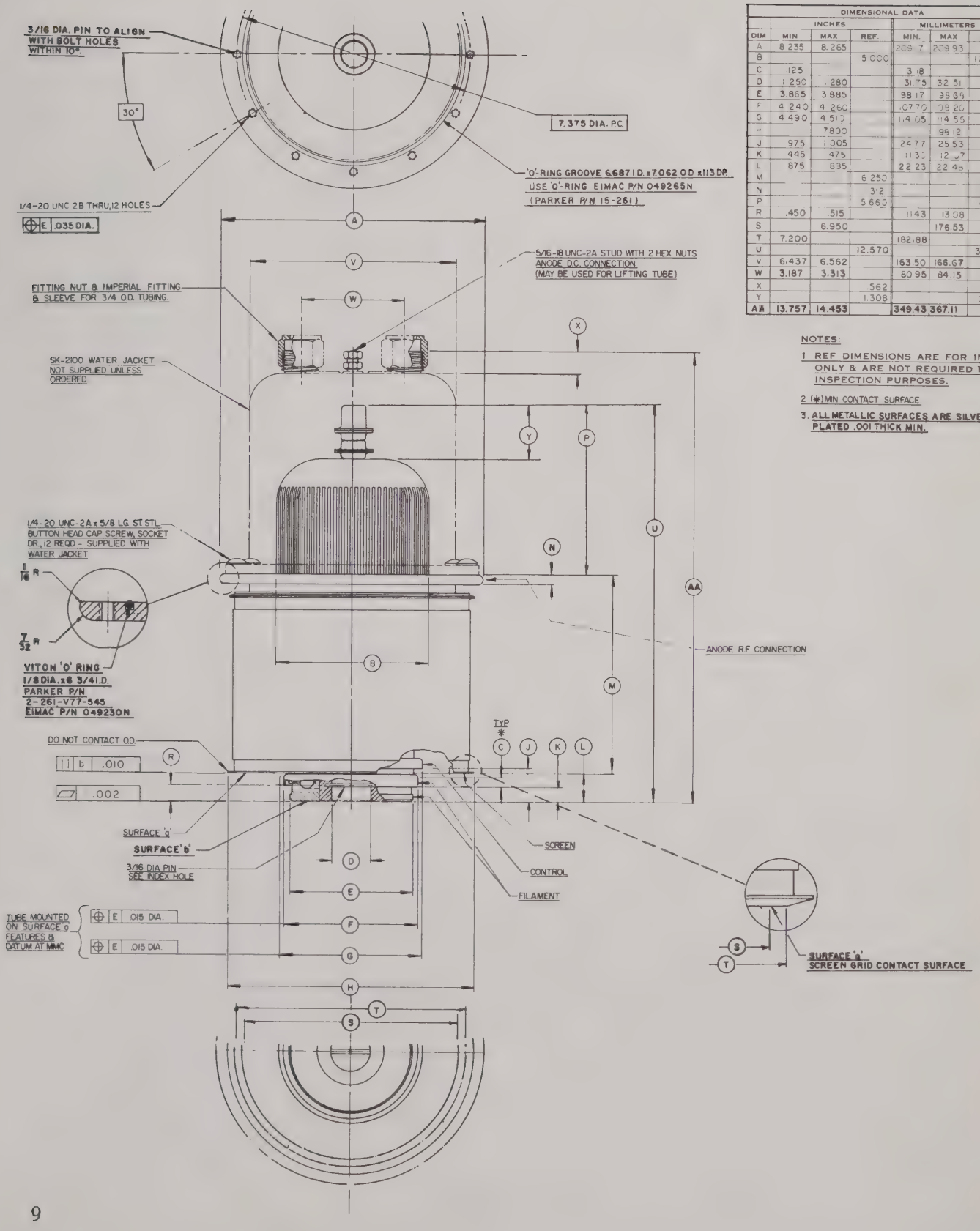
8959

Eimac


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
SCREEN VOLTAGE: 2500 Vdc
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
400
200
0
-200
-400
-600
-800
-1000
0
2
4
6
8
10
12
14
16
18
20
12
8.0
4.0
2.0
1.0
-3.0
0
1.2
0
140
110
80
50
30
15
5
1
.100
.001
.200
0
-.050
-.050
0
0
4173

8959

Eimac



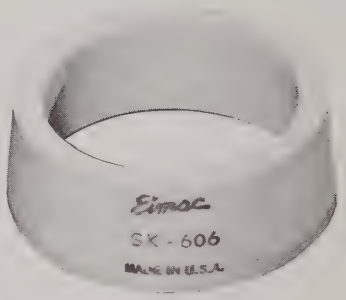
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF.	MIN.	MAX	REF
A	8.235	8.265		209.7	209.93	
B			5.000			127.00
C	.125			3.18		
D	1.250	.280		31.75	32.51	
E	3.865	3.885		98.17	98.69	
F	4.240	4.260		107.70	108.20	
G	4.490	4.510		114.05	114.55	
-		7.800			198.12	
J	.975	1.005		24.77	25.53	
K	.445	.475		11.30	12.07	
L	.875	.885		22.23	22.48	
M			6.250			58.75
N			.312			7.92
P			5.660			43.76
R	.450	.515		11.43	13.08	
S		6.950			176.53	
T	7.200			182.88		
U			12.570			319.28
V	6.437	6.562		163.50	166.67	
W	3.187	3.313		80.95	84.15	
X			.562			14.27
Y			1.308			33.22
AA	13.757	14.453		349.43	367.11	

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) MIN. CONTACT SURFACE.
3. ALL METALLIC SURFACES ARE SILVER PLATED .001 THICK MIN.

TECHNICAL DATA

SK-606
SK-626
SK-636B
SK-646
AIR-SYSTEM CHIMNEYS

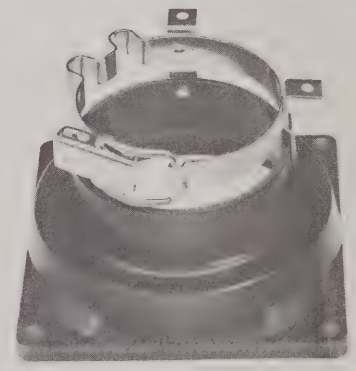


The EIMAC SK-606, SK-626, SK-636B, and SK-646 Air-System Chimneys are intended for use with those tube and socket combinations listed below.

They are used to direct cooling air into the anode radiator on the tube types listed.

The SK-636B is also designed to hold the tube in use in place by means of a clamping band around the tube's radiator.

MATERIALS

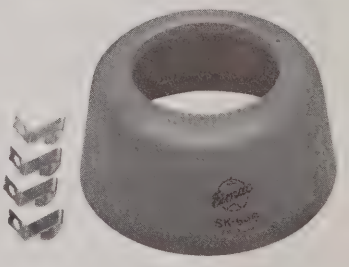


The SK-606 and SK-626 are made of high-temperature ceramic. The SK-636B is molded of diallyl meta-phthalate, and the clamping band is of beryllium copper. A neoprene "O" ring is furnished in a recess at the bottom of the chimney to more effectively seal the chimney to the socket. The SK-646 is molded of silicone resin glass fiber.

INSTALLATION

The SK-606 and SK-626 ceramic chimneys are installed by slipping them over the tube's radiator. They are held in place by their own weight or by a suitable clamping means.

The SK-646 also slips over the tube's radiator, and four clips are provided to secure the chimney in position.



The SK-636B is secured to the chassis over the companion Air-System Socket by means of four #6 screws (not provided). The clamping band includes two solder lugs to facilitate making electrical contact to the tube anode.

CHIMNEY/TUBE/SOCKET COMBINATIONS

Chimney	Socket	Tube
SK-606	SK-600	7203/4CX250B
	SK-600A	8957/4CX250BC
	SK-610	8621/4CX250FG
	SK-610A	7580W/4CX250R
	SK-640	8321/4CX350A
SK-626	SK-620	8322/4CX350F
SK-636B	SK-620A	8904/4CX350FJ
	SK-630	7034/4X150A
	SK-630A	7609

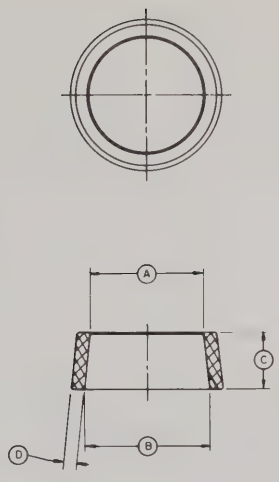
Chimney	Socket	Tube
SK-646	SK-607	8809/4CX600J
SK-646	SK-600	8930
	SK-600A	
	SK-610	
	SK-610A	
	SK-640	
SK-606	SK-700	8167/4CX300A
	SK-710	8561/4CX300Y
	SK-710A	
	SK-711	
	SK-711A	

Net Weight (approximate) . . . . . SK-606, SK-626, SK-636B 1.4 oz; 49.5 gms
SK-646 2.7 oz; 76.5 gms

(Effective 11-1-74) © 1963, 1966, 1974 Varian Printed in U.S.A.

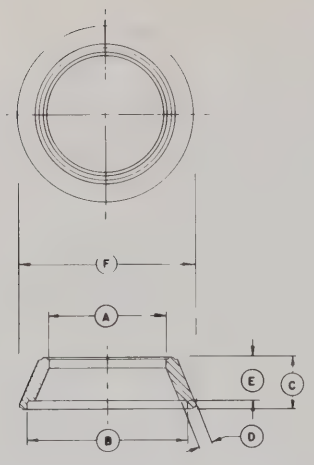
SK-606, SK-626, SK-636B, SK-646

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.635	1.700	41.53	43.18
B	1.781	1.881	45.24	47.78
C	0.812	0.875	20.62	22.23
D	0.156	0.218	3.96	5.54



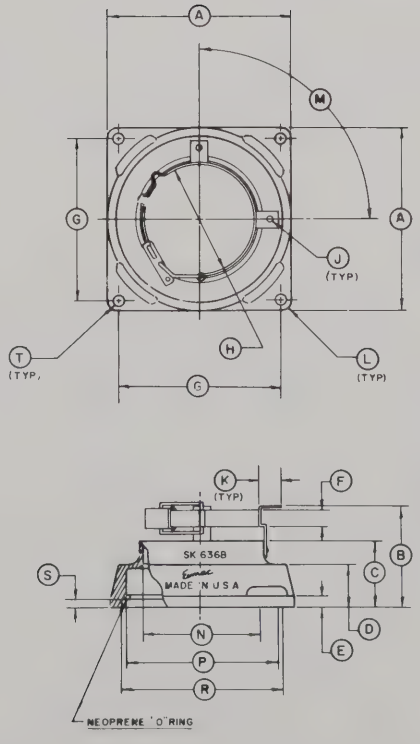
SK-606

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.650	1.720	41.91	43.69
B	2.300	2.362	58.42	60.00
C	0.698	0.738	17.73	18.75
D	0.156	0.218	3.96	5.54
E	0.573	0.613	14.55	15.57
F	- -	2.560	- -	65.02



SK-626

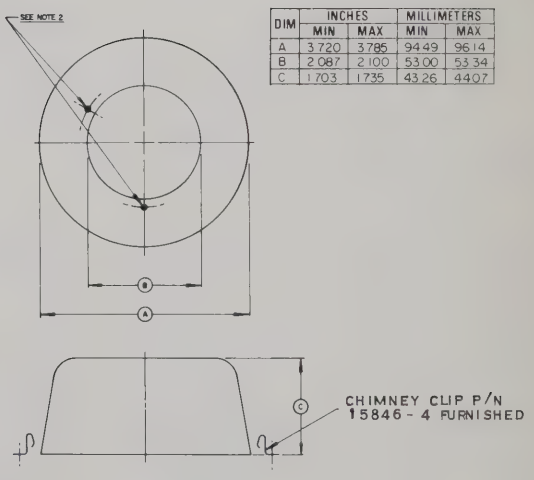
DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	2.609	2.641	- -	66.27	67.08	- -
B	1.607	1.677	- -	40.82	42.60	- -
C	1.109	1.141	- -	28.17	28.98	- -
D	0.560	0.600	- -	14.22	15.24	- -
E	0.155	0.187	- -	3.94	4.75	- -
F	0.219	0.281	- -	5.56	7.14	- -
G	2.335	2.365	- -	59.31	60.07	- -
H	1.580	1.620	- -	40.13	41.15	- -
J	0.083	0.103	- -	2.11	2.62	- -
K	0.281	0.343	- -	7.14	8.71	- -
L	- -	- -	1/8 R	- -	- -	3.18R
M	- -	- -	90°	- -	- -	90°
N	1.651	1.661	- -	41.94	42.19	- -
P	2.306	2.340	- -	58.57	59.44	- -
R	2.480	2.510	- -	63.00	63.75	- -
S	0.111	0.121	- -	2.82	3.07	- -
T	0.151	0.161	- -	3.84	4.09	- -



NOTES
1 STRAP & BRACKETS OF CLAMP - MATL BE CU SILVER PLATED
2 CHIMNEY-MATL DIALLYL META-PHTHALATE
3 CLAMP PROVIDES A MIN. 3 LBS. RETENTION ON A 1.625 DIA. TUBE

SK-636B

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	3.720	3.785	94.49	96.14
B	2.087	2.100	53.00	53.34
C	1.703	1.735	43.26	44.07



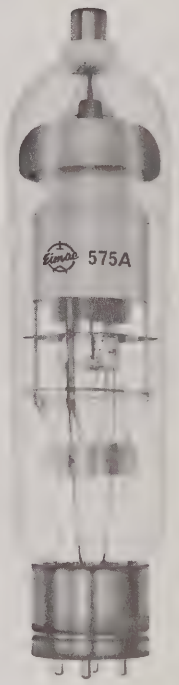
NOTES
1 MATL. CHIMNEY, GLASS FIBER, REINFORCED SILICONE RESIN. (MAX. TEMP. 370°C)
CHIMNEY CLIP, BE.-CU ALLOY NO. 172, (CADMIUM PLTD.)
2 THE TWO HOLES NOTED HAVE NO FUNCTION WITH THIS CHIMNEY.

SK-646

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

575A
673
MERCURY-VAPOR RECTIFIERS

The EIMAC 575A and 673 are half-wave mercury vapor-rectifiers incorporating features which enable them to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The tubes differ only in basing.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage	5.0	volts
Current	9.0 to 11.5	amperes
Filament Heating Time	30	seconds
Anode Starting Voltage (approx.)	20	volts

MECHANICAL

Base	575A	50 watt, A4-29
	673	Industrial, A4-18
Recommended Socket	575A	E. F. Johnson #123-211
	673	E. F. Johnson #123-206
Maximum Overall Dimensions:		
Length	575A	11-1/8 inches
	673	11-7/16 inches
Diameter		2-9/16 inches
Net Weight		12 ounces

MAXIMUM RATINGS (per tube)

CONDENSED MERCURY TEMPERATURE LIMITS*	20-50	20-60	°C
PEAK INVERSE ANODE VOLTAGE	15	10	kV
PEAK ANODE CURRENT:			
Quadrature Filament Excitation**	10	10	Amps
In-Phase Filament Excitation	6	7	Amps
AVERAGE ANODE CURRENT: (Maximum averaging time - 20 seconds)			
Quadrature Filament Excitation**	2.5	2.5	Amps
In-Phase Filament Excitation	1.5	1.75	Amps
MAXIMUM AC SHORT CIRCUIT CURRENT***	100	100	Amps

*Condensed Mercury temperature rises approximately 18°C above ambient.
**Quadrature excitation refers to filament voltage 90°±30° out of phase with anode voltage.
***Max. duration 100 milliseconds.

APPLICATION

MECHANICAL

Mounting: The 575A and 673 must be mounted vertically base down.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury should be kept within the ranges given under "MAXIMUM RATINGS." This temperature should be maintained at 40°±5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the

(Revised 4-1-67) © 1964, 1967 by Varian
Printed in U.S.A.

recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube. The approximate condensed-mercury temperature rise above ambient is 18°C.

ELECTRICAL

Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range of 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

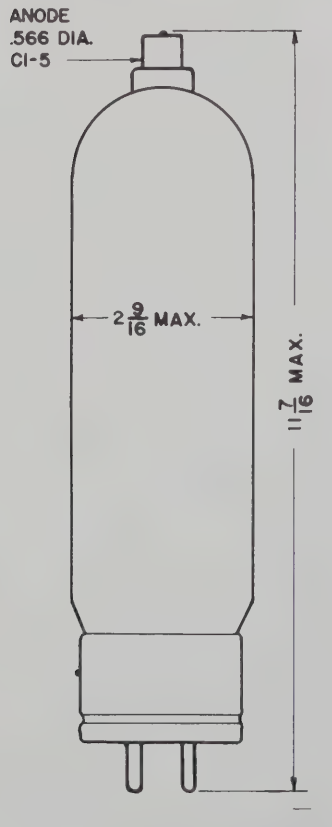
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

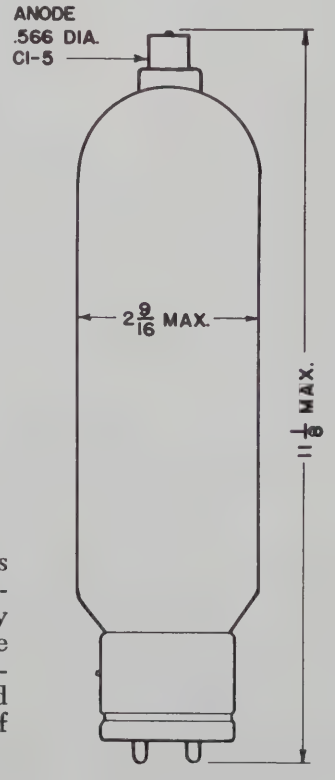
When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the tube should be isolated from such fields as exist around a transmitter or other similar equipment.

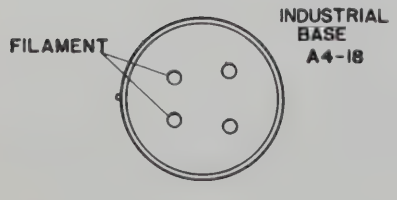
673

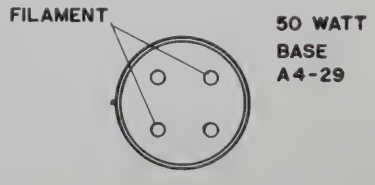


575-A



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with EIMAC, Division of Varian.





TECHNICAL DATA

8963

HIGH-MU VHF TRANSMITTING TRIODE

The EIMAC 8963 is a ceramic/metal high-mu triode designed especially for use in the VHF spectrum as a cathode-driven Class AB rf amplifier or Class C power amplifier and for pulsed rf amplifier or modulator service.

The 8963 makes use of beam-forming cathode and control grid geometry to produce high gain, low grid interception, and zero-bias operation capability in linear-amplifier service. In a typical VHF television amplifier application 25 kW of useful output (Sync level) is obtained with a bandwidth (1 dB) of 6 MHz with a stage gain of 15 dB.

The 8963 has coaxial terminals for which contact collets are available from EIMAC. The tube is forced-air cooled with an anode dissipation rating of 20,000 watts.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-Coated, Unipotential		
Heater Voltage	16.0 ± 0.8	V
Heater Current, at 16.0 volts	13.0	A
Amplification Factor (Average)	260	
Transconductance, average (I_b = 2.0 Adc)	90,000	μmhos
Direct Interelectrode Capacitances (grid grounded) [2]		
Cin	79	pF
Cout	21	pF
Cpk	0.1	pF
Frequency of Maximum Rating:		
CW	260	MHz
Pulsed	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:		
Length	6.700 In; 170	mm
Diameter	9.175 In; 233	mm
Net Weight	21.5 lb; 9.7	kg

(Effective 4-1-75) © 1975 by Varian

Printed in U.S.A.

Operating Position		Any
Maximum Operating Temperature:	Base seals & envelope	250°C
	Anode Core	275°C
Cooling		Forced Air
Base		Special Coaxial

Recommended Contact Collets:

Tube Element	EIMAC Part No.
Heater	154373
Heater-Cathode	154374
Grid	154375
Anode	154376

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	100	WATTS

1. Approximate value.
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 260 MHz)
Class

Plate Voltage	8000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[1]	1.8	Adc
Single-Tone Plate Current[2]	5.0	Adc
Single-Tone Grid Current[1]	36	mAdc
Driving Power[1]	498	W
Plate Dissipation	14.0	kW
Single-Tone Plate Output Power	26.0	kW
Resonant Load Impedance	850	Ω
Drive Impedance (Resistive component)	15.9	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN

Class C Telegraphy or FM

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-300	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	100	WATTS

1. Approximate value.
2. Adjust to obtain specified value.

TYPICAL OPERATION

Plate Voltage	9000	Vdc
Grid Voltage	-100	Vdc
Plate Current[2]	4.9	Adc
Grid Current[1]	290	mAdc
Peak rf Grid Voltage[1]	260	v
Calculated Driving Power[1]	77	W
Plate Input Power	43.9	kW
Plate Dissipation[1]	10.5	kW
Plate Output Power[1]	33.4	kW
Resonant Load Impedance	933	Ω

RADIO FREQUENCY POWER AMPLIFIER CATHODE DRIVEN Class C - Telegraphy or FM

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-300	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	100	WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	7500	Vdc
Grid-to-Cathode Voltage	-80	Vdc
Plate Current	4.7	Adc
Grid Current[1]	425	mAdc
Peak rf Cathode Voltage	240	v
Cathode Driving Power[1]	1070	W
Plate Dissipation[1]	7.78	kW
Plate Load Resistance	830	Ω
Plate Output Power[1]	27.5	kW

RADIO FREQUENCY POWER AMPLIFIER
CATHODE DRIVEN Class B Television Service

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20,000 WATTS
GRID DISSIPATION	100 WATTS

1. Approximate value.

TYPICAL OPERATION (Frequencies to 260 MHz)
Class B

Plate Voltage	7500 Vdc
Grid Voltage	0 Vdc
Zero-Signal Plate Current[1]	1.8 Adc
Effective rf Load Resistance	670 Ω
Plate Current: Blanking Level	4.43 Adc
Sync. Peak Level	5.75 Adc
Grid Current: Blanking Level[1]	17 mAdc
Sync. Peak Level[1]	30 mAdc
rf Cathode Voltage Peak: Blanking Level.[1]	130 v
Sync. Peak Level[1]	150 v
Driving Power: Blanking Level[1]	398 w
Sync. Peak Level[1]	687 w
Plate Power Output: Blanking Level	16.5 kw
Sync. Peak Level	27.5 kw

SWITCH TUBE OR PULSED REGULATOR SERVICE
GRID DRIVEN

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	18,000 VOLTS
DC GRID VOLTAGE	-300 VOLTS
PEAK PLATE CURRENT[2]	100 AMPERES
PLATE DISSIPATION[1]	20,000 WATTS
GRID DISSIPATION[1]	100 WATTS
PULSE LENGTH	See Note 2
DUTY FACTOR	See Note 2

1. Dissipation values shown are average.
2. Pulse length, peak current, and duty are inter-related. See PULSE DERATING CHART.

PULSED RADIO FREQUENCY POWER AMPLIFIER
Class C - CATHODE DRIVEN

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 VOLTS
DC GRID VOLTAGE	-300 VOLTS
PLATE CURRENT[2]	50 AMPERES
PLATE DISSIPATION[1]	20,000 WATTS
GRID DISSIPATION[1]	100 WATTS
PULSE LENGTH	See Note 2
DUTY FACTOR	See Note 2

1. Dissipation values shown are average.
2. Pulse length, peak current, and duty are inter-related. See PULSE DERATING CHART. The anode current values shown are average during the pulse.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurement. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater Current, at 16.0 volts	12.0	14.0	A
Cathode Warmup Time	3.0	---	Min.
Interelectrode Capacitances (grid grounded)[1]			
Cin	75.0	84.0	pF
Cout	19.0	23.0	pF
Cpk	---	0.15	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - Part numbers of available EIMAC collets are listed under MECHANICAL. These collets may be soft-soldered to appropriate VHF line or cavity elements. The collets provide low-inductance connections between tube and circuitry and serve to draw off a portion of the heat released during normal operation. The tube may be mounted in any position, at the convenience of the equipment designer.

HEATER-CATHODE OPERATION - The nominal heater voltage for the 8963 is 16.0 volts and should normally be held within plus or minus five percent of this value for good life and stable performance. Regulation to a tolerance better than ±5% normally will be beneficial as regards life expectancy, and if variation can be held to ±1% then the voltage can be reduced to as low as 15.2 volts, for greatest life expectancy. When this is done, however, voltage should be set and monitored with a (true rms-responding type) voltmeter of high accuracy.

For pulse service, the full nominal value of 16.0 volts should be used on the heater.

The oxide coated unipotential cathode must be protected against excessively high emission current. The maximum rated dc input current (anode) is 5.0 Adc for all types of operation except pulse. Rated heater voltage should be applied for a minimum of 3 minutes before other operating voltages are applied. If reduced heater voltage is being used, with close voltage regulation, a warmup time of longer than 3 minutes should be allowed.

INTERLOCKS - An interlock device should be provided to insure that cooling air flow is established before application of electrical power, including the heater. The circuit should be so arranged that rf drive cannot be applied in the absence of normal plate voltage.

COOLING - The maximum temperature rating for the base seals and envelope of the 8963 is 250°C, and for the anode core 275°C. Sufficient forced-air cooling must be provided so these ratings are not exceeded. Minimum air flow requirements, for 35°C inlet air, at sea level and at 10,000 feet elevation, are shown in the table, for air flowing in a base-to-anode direction. The pressure drop values shown are for the anode cooler only and do not include any losses which may occur with any specific chimney or socketing arrangement. In cases where the tube base is not directly in the anode cooling air stream, special provision must be made for separate base cooling.

Air cooling should be applied before or simultaneously with the application of heater voltage and should normally be maintained for a short period of time after all voltages are removed to allow for tube cool-down. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

SEA LEVEL		
Dissipation Anode kW	Air Flow CFM	Approx. Press. Drop, In. H_2O
12.0	250	0.45
14.0	365	1.0
16.0	505	1.8
18.0	650	2.8
20.0	820	4.1
10,000 FEET ALT.		
12.0	365	0.66
14.0	533	1.5
16.0	740	2.6
18.0	950	4.1
20.0	1200	6.0

INPUT CIRCUIT - When the 8963 is operated as a grounded-grid rf amplifier, the use of a matching network in the cathode circuit is recommended. For best results with a single-ended amplifier, and depending on the application, it is suggested the network have a "Q" of at least 2, and higher if possible.

X-RADIATION HAZARD - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-radiation as the voltage is increased. The 8963, operating at the voltage and current levels for which it is rated as a switch tube or pulsed regulator, is a potential X-ray hazard. Only limited shielding is

afforded by the tube envelope. Moreover, the X-radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding may be required on all sides of the tube to provide protection throughout its life, and periodic checks on the X-ray level should be made. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment. If it has been determined that shielding is normally required, the equipment should never be operated with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction as X-ray exposure may result.

FAULT PROTECTION - In addition to normal cooling airflow interlock and plate over-current interlock it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high plate voltage.

In all cases some protective resistance, at least 10 ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. In pulse service, where stored energy is high, it is recommended that some form of electronic crowbar be used which will discharge power supply capacitors in as short a time as possible following indication of start of a plate arc.

HIGH VOLTAGE - Normal operating voltages used with the 8963 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

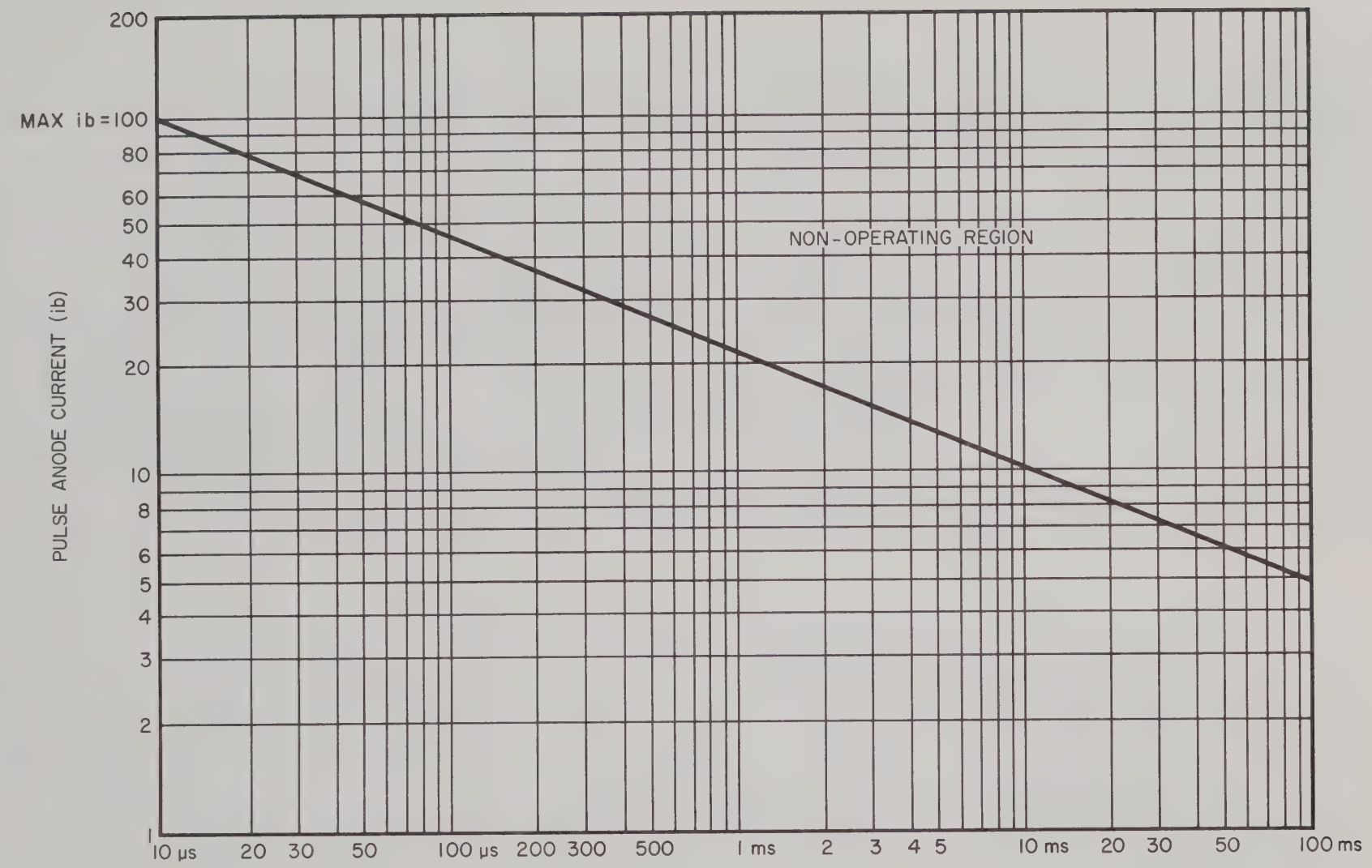
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 8963, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--- the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

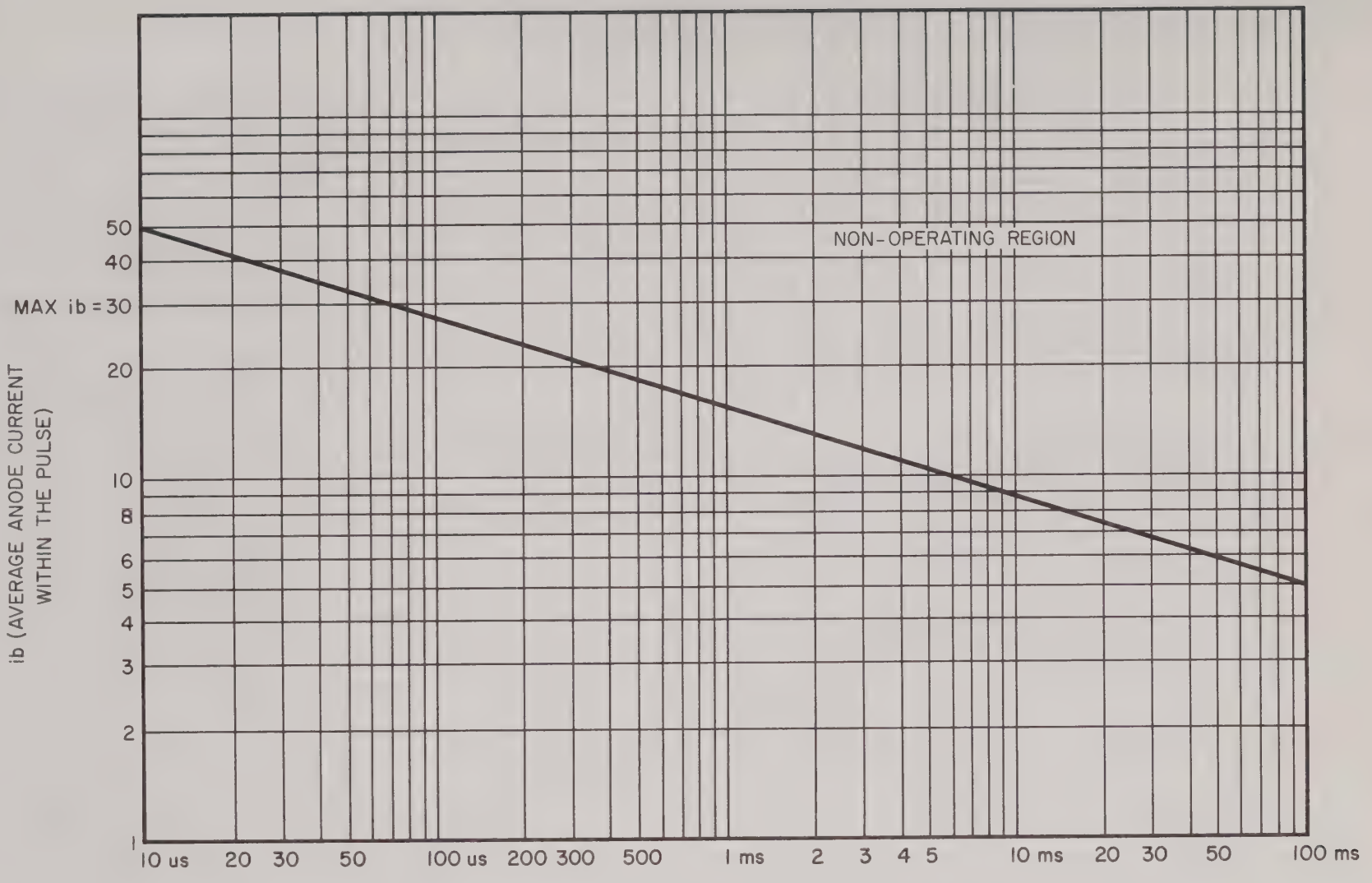
SPECIAL APPLICATIONS - For information on complete UHF-TV cavity amplifier assemblies, or if it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for recommendations.



Note: Pulse Anode Current (ib) capability is dependent on pulse length (tp) and Duty Factor (Du). Maximum ib for any given tp is shown; maximum Du may then be derived from:

$$5.0 = ib\sqrt{Du}$$

PULSE DERATING CHART, TYPE 8963 - SWITCH TUBE OR PULSE MODULATOR SERVICE



Note: Pulse Anode Current (ib) capability is dependent on pulse length (tp) and Duty Factor (Du). Maximum ib for any given tp is shown; maximum Du may then be derived from:

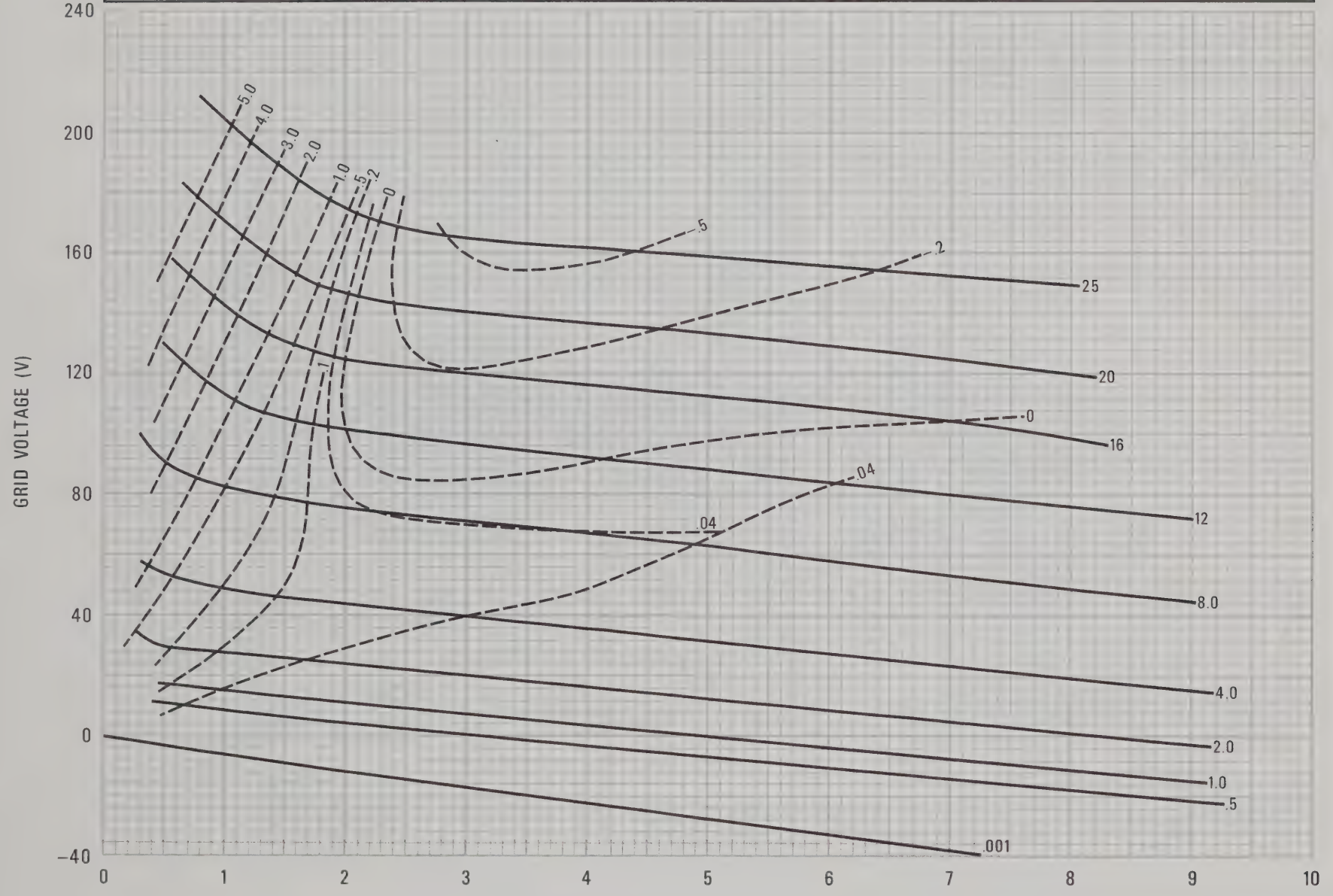
$$5.0 = ib\sqrt{Du}$$

PULSE DERATING CHART, TYPE 8963 - PULSED RF AMPLIFIER SERVICE

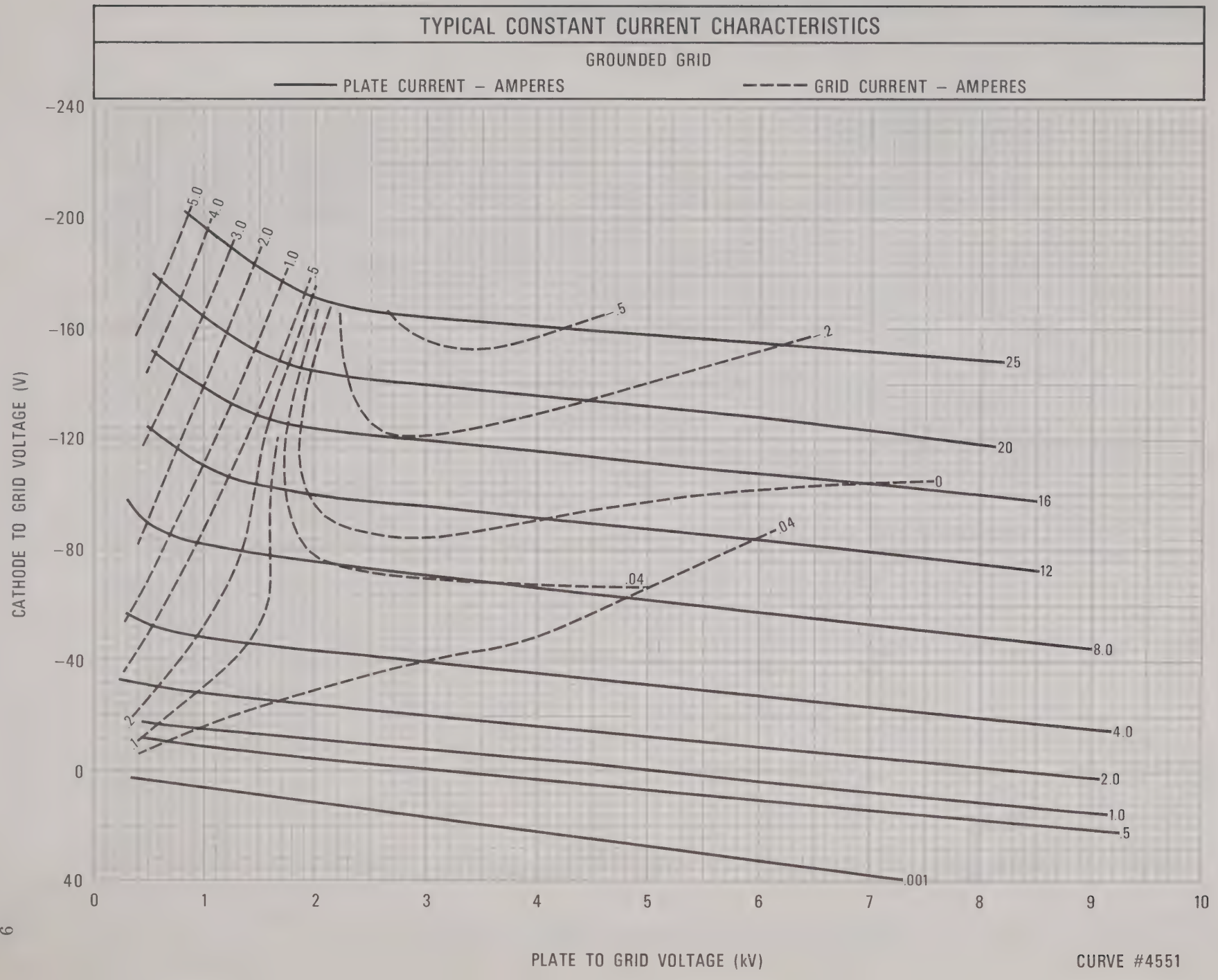
TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE

PLATE CURRENT – AMPERES ---- GRID CURRENT – AMPERES



CURVE #4550

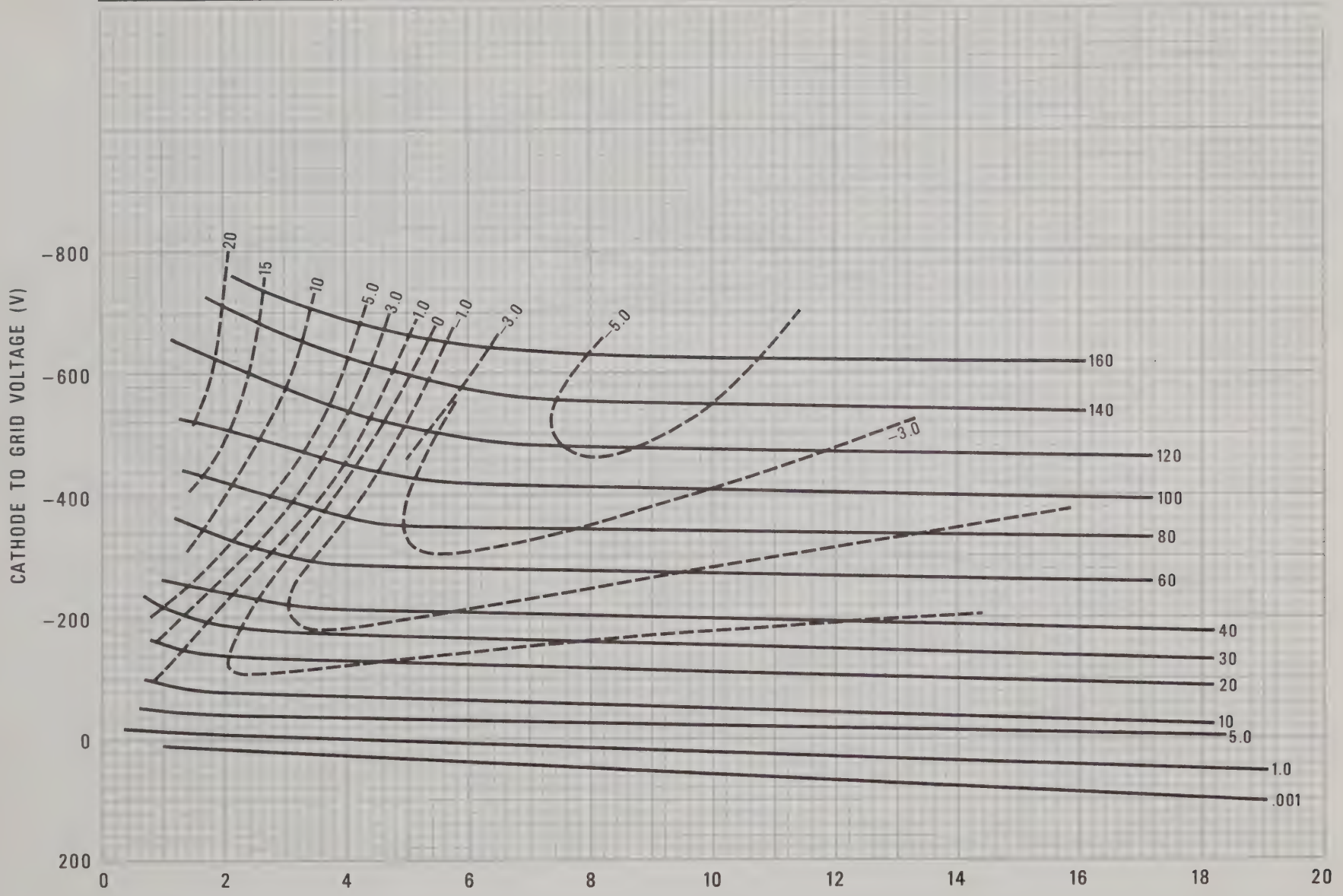

TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
-240
-200
-160
-120
-80
-40
0
40
0
1
2
3
4
5
6
7
8
9
10
PLATE TO GRID VOLTAGE (kV)
5.0
4.0
3.0
2.0
1.0
.5
.5
2
25
20
0
16
.04
12
.04
8.0
4.0
2.0
1.0
.5
.001
2
1

CURVE #4551

TYPICAL CONSTANT CURRENT CHARACTERISTICS

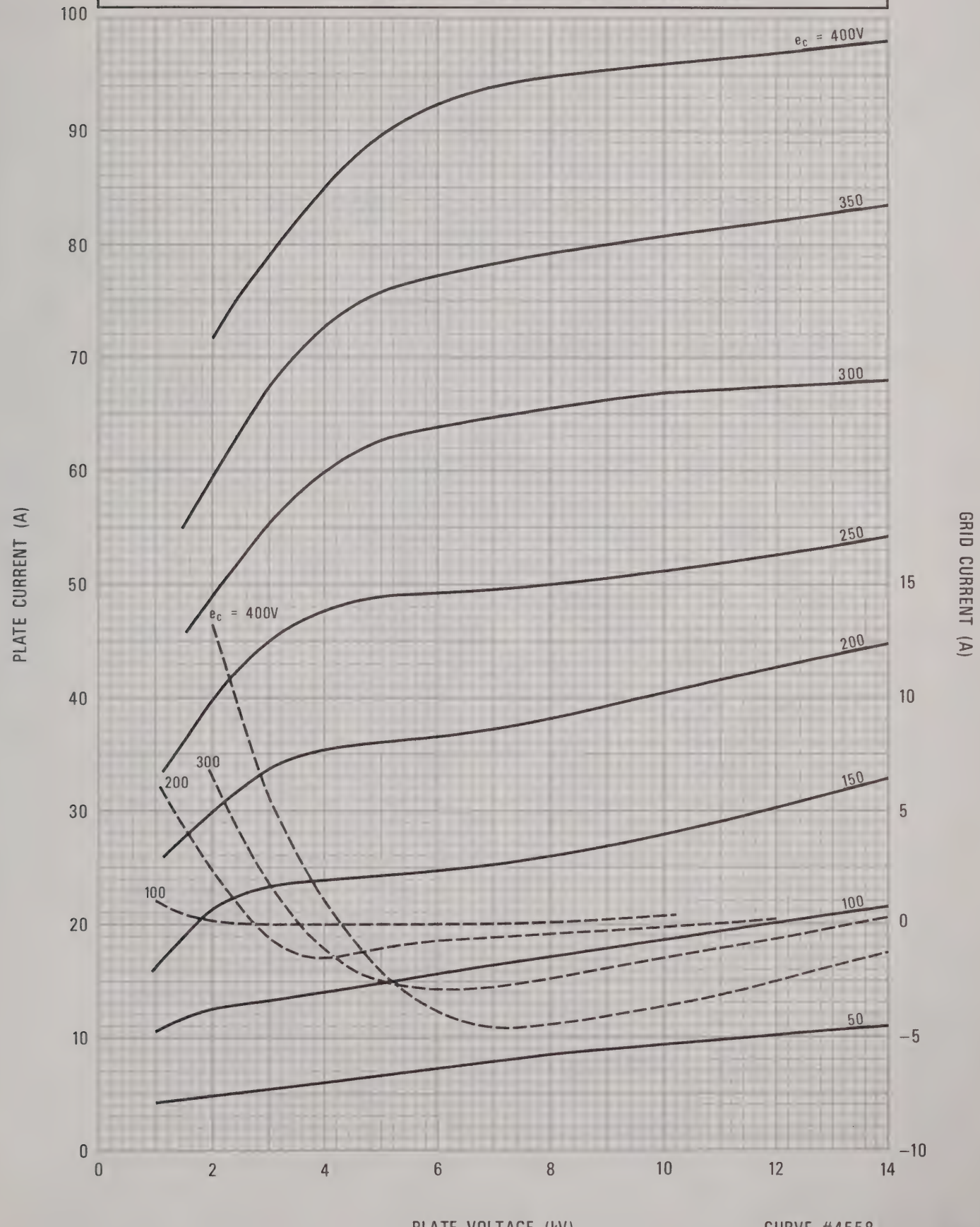
GROUNDED GRID

——— PLATE CURRENT – AMPERES – – – – GRID CURRENT – AMPERES



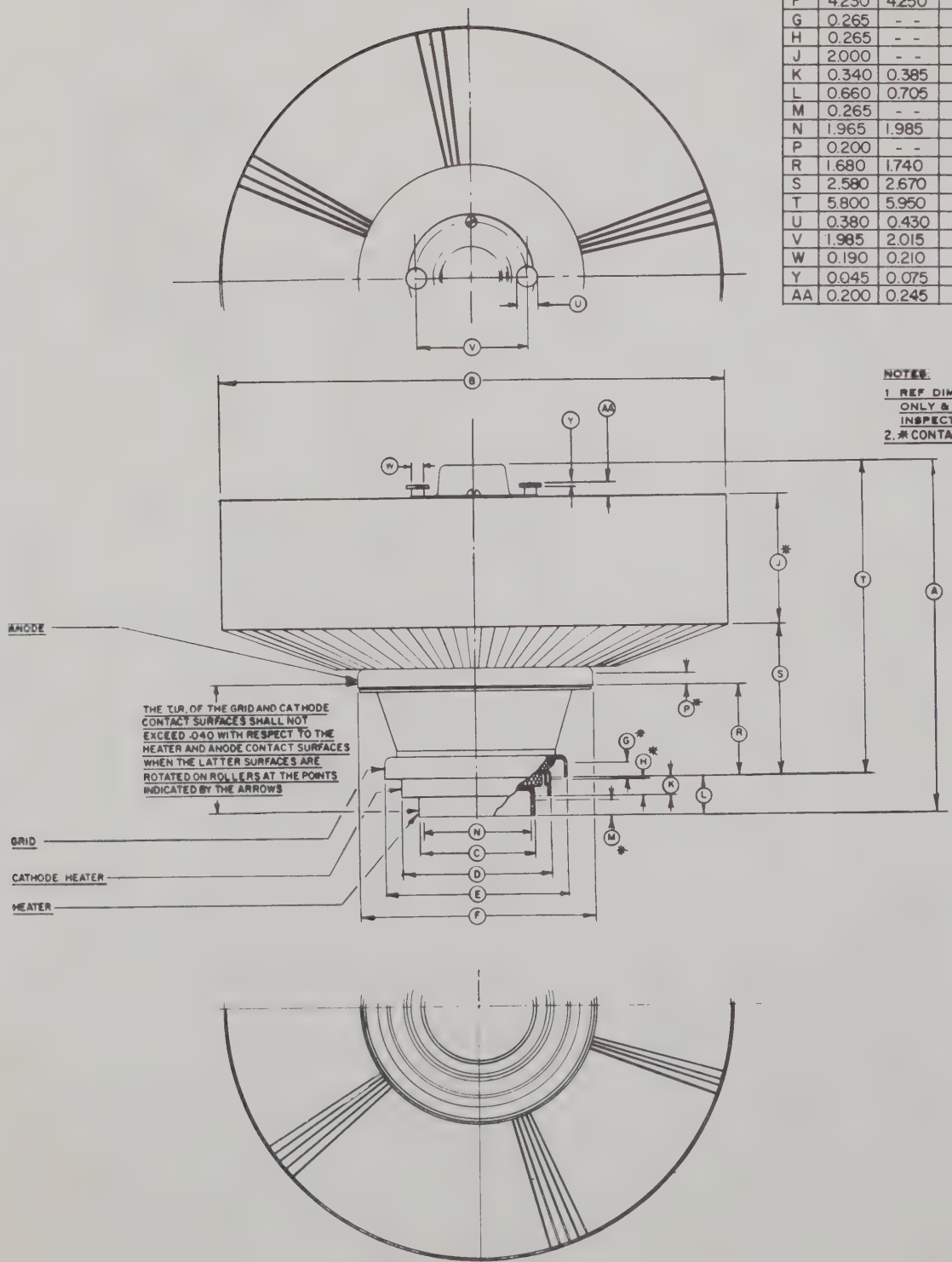
CURVE #4556

TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS



CURVE #4558

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	6.700	- -	- -	170.18	- -
B	9.175	9.225	- -	233.08	234.32	- -
C	2.090	2.110	- -	53.09	53.59	- -
D	3.690	2.720	- -	68.33	69.09	- -
E	3.275	3.310	- -	83.19	84.07	- -
F	4.230	4.250	- -	107.44	107.95	- -
G	0.265	- -	- -	6.73	- -	- -
H	0.265	- -	- -	6.73	- -	- -
J	2.000	- -	- -	50.80	- -	- -
K	0.340	0.385	- -	8.64	9.78	- -
L	0.660	0.705	- -	16.76	17.91	- -
M	0.265	- -	- -	6.73	- -	- -
N	1.965	1.985	- -	49.92	50.42	- -
P	0.200	- -	- -	5.08	- -	- -
R	1.680	1.740	- -	42.67	44.20	- -
S	2.580	2.670	- -	65.53	67.82	- -
T	5.800	5.950	- -	147.32	151.13	- -
U	0.380	0.430	- -	9.65	10.92	- -
V	1.985	2.015	- -	50.42	51.18	- -
W	0.190	0.210	- -	4.83	5.33	- -
Y	0.045	0.075	- -	1.14	1.91	- -
AA	0.200	0.245	- -	5.08	6.22	- -



NOTES:

1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE



EIMAC
Division of Varian
San Carlos, California

EIMAC and EIA
POWER GRID TUBE NUMBER
CROSS-REFERENCE LIST

JULY 1, 1969

(Effective 7-1-69) © 1965, 1968, 1969 by Varian Associates

Printed in U.S.A.

EIMAC EIA POWER GRID TUBE

EIMAC to EIA

Eimac No.	*EIA No.*
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R/8745
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW25,000A3	----
3CW30,000H3	----
3CW40,000H3	----
3CW100,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-1000A	8166
4CN15A	----

Eimac No.	*EIA No.*
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV100,000C	8351
4CV250,000A	----
4CV250,000V	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	----
4CW25,000A	----
4CW50,000E	----
4CW100,000D	----
4CW250,000A	----
4CW250,000V	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX600B	----
4CX600F	----
4CX600J	8809
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	----
4CX5000R	8170W
4CX10,000D	8171
4CX15,000A	8281
4CX15,000J	----
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----

Eimac No.	*EIA No.*
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
172	8295
172A	8295A
175A	----
177A	----
177WA	----
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6884	6884
6894	6896
6895	6895
7211	7211
7480	7480
7527	7527
7698	7698
7843	7843
8295A	8295A
8432	8432
8533	8533
8755	8755
8756	8756
8757	8757

NUMBER CROSS-REFERENCE LIST

EIA to EIMAC

EIA No.	Eimac No.
2C39A	2C39A
2C39WA	2C39WA
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7480	7480
7527	7527
7580W	4CX250R
7698	7698
7815	3CPN10A5
7815R	3CPX100A5
7843	7843
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295	172
8295A	172A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8432	8432
8438	4-400A
8533	8533
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8745	3CPX100A5
8755	8755
8756	8756
8757	8757
8809	4CX600J


Eimac

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8163
3-400Z

HIGH-MU POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	14.5	amperes
Amplification Factor (Average)	200	
Interelectrode Capacitances (Average):*		
Grid-Filament	7.4	pF
Grid-Plate	4.1	pF
Plate-Filament	0.07	pF
Frequency for Maximum Ratings	110	MHz

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-all Dimensions:	
Height	5.25 inches
Diameter	3.57 inches
Net Weight	7 ounces

*In Shielded Fixture

(Effective 5-1-68) © 1961, 1967, 1968 by Varian

Printed in U.S.A.

R-F LINEAR AMPLIFIER GROUNDED-GRID, CLASS-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Single-Tone Conditions)

DC Plate Voltage	3000 volts
Zero-Sig DC Plate Current*	100 ma
Max-Sig DC Plate Current	333 ma
Max-Sig DC Grid Current	120 ma
Driving Impedance	122 ohms
Resonant Load Impedance	4750 ohms
Max-Sig Driving Power	32 watts
Peak Envelope Plate Output Power	655 watts

TYPICAL OPERATION (Minimum Distortion Products)

DC Plate Voltage	2000 volts
Zero-Sig DC Plate Current*	62 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	148 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	87 ma
Peak Envelope Useful Output Power	445 watts
Resonant Load Impedance	2750 ohms
Intermodulation Distortion Products	—40 db

TYPICAL OPERATION (Minimum Distortion Products at 1 KW PEP Input)

DC Plate Voltage	2500 volts
Zero-Sig DC Plate Current*	73 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	142 ma
Two-Tone DC Plate Current	274 ma
Two-Tone DC Grid Current	82 ma
Peak Envelope Useful Output Power	560 watts
Resonant Load Impedance	3450 ohms
Intermodulation Distortion Products	—35 db

TYPICAL OPERATION (Minimum Distortion Products at 1500 Volts Plate Voltage)

DC Plate Voltage	1500 volts
Zero-Sig DC Plate Current*	46 ma
Single-Tone DC Plate Current	400 ma
Single-Tone DC Grid Current	163 ma
Two-Tone DC Plate Current	265 ma
Two-Tone DC Grid Current	92 ma
Peak Envelope Useful Output Power	300 watts
Resonant Load Impedance	1620 ohms
Intermodulation Distortion Products	—37 db

A-F AMPLIFIER OR MODULATOR, CLASS-B

MAXIMUM RATINGS (PER TUBE)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.400 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

DC Plate Voltage	3000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	200 ma
Max-Sig DC Plate Current	666 ma
Max-Sig DC Grid Current	240 ma
Driving Power	26 watts
Peak A-F Driving Voltage (per tube)	88 volts
Load Resistance, Plate-to-Plate	9500 ohms
Max-Sig Plate Output Power	1310 watts

R-F POWER AMPLIFIER OR OSCILLATOR, CLASS-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	0.350 AMP
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	333 ma
DC Grid Voltage	—75 volts
DC Grid Current	130 ma
Peak R-F Grid Voltage	187 volts
Grid Driving Power	25 watts
Plate Output Power	730 watts

R-F POWER AMPLIFIER PLATE-MODULATED

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.275 AMP
PLATE DISSIPATION	270 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION

DC Plate Voltage	3000 volts
DC Plate Current	245 ma
DC Grid Voltage	—90 volts
DC Grid Current	100 ma
Peak R-F Grid Voltage	185 volts
Grid Driving Power	18 watts
Plate Output Power	550 watts

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

*Approximate Value

APPLICATION

Mounting — The 3-400Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling — Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an inlet air temperature of 55°C. At higher inlet air temperatures, higher altitudes, or at frequencies above 30 MHz, the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead. In all cases, air flow rates in excess of the minimum requirements will prolong tube life.

Class-C Operation — Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

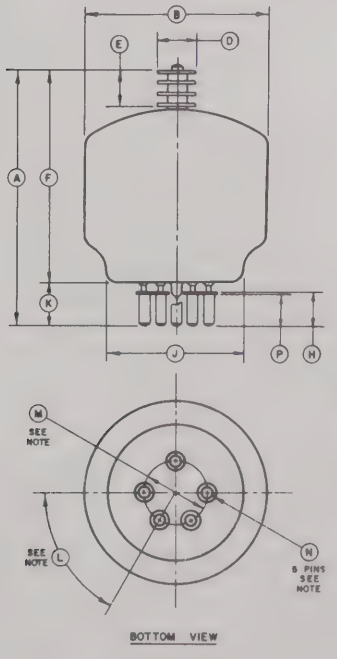
Filament Operation—The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

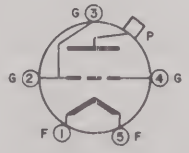
Intermodulation Distortion — Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

Input Circuit — When the 3-400Z is operated as a grounded-grid r-f amlpifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

3-400Z OUTLINE DRAWING AND PIN CONNECTIONS

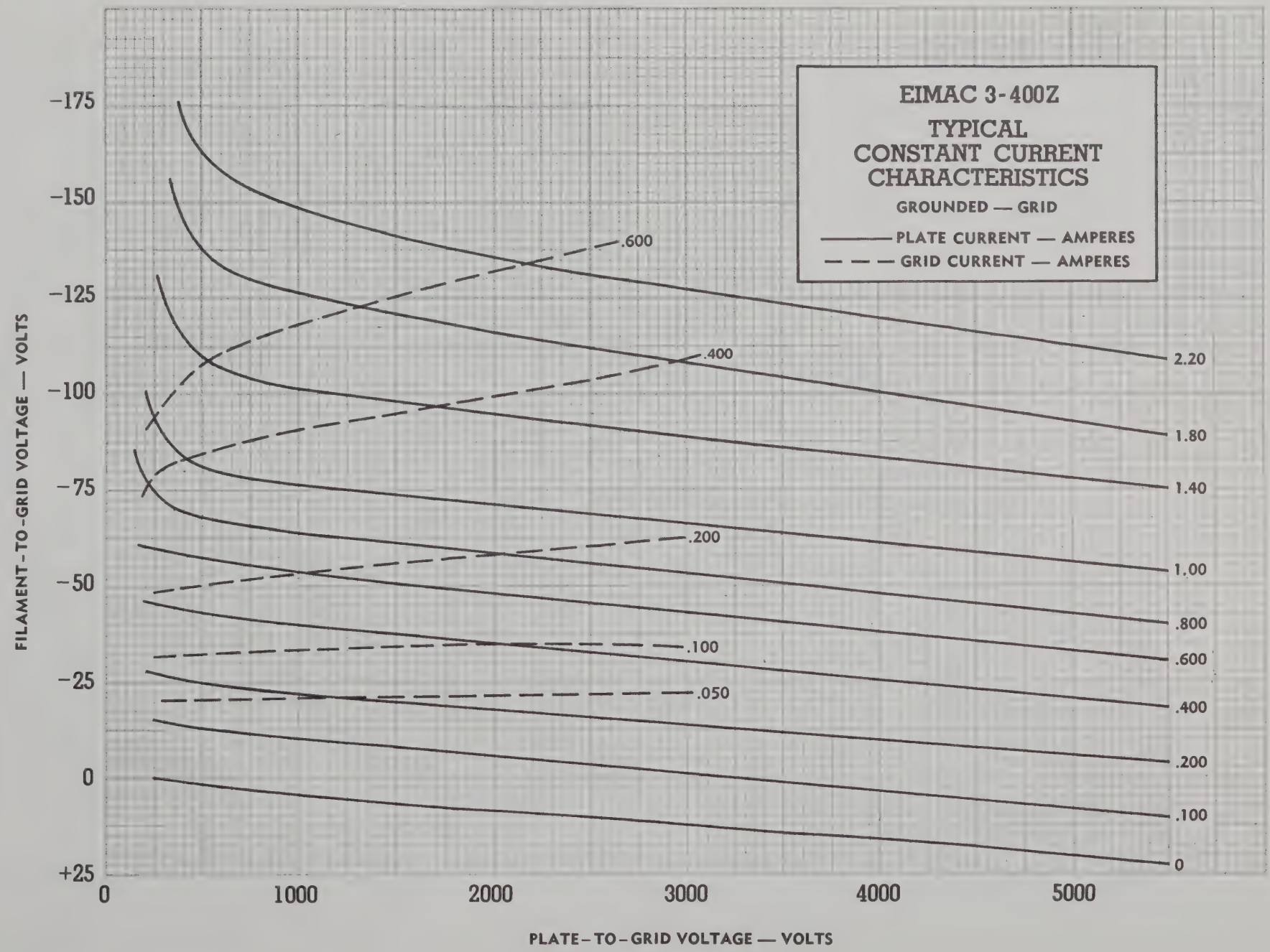


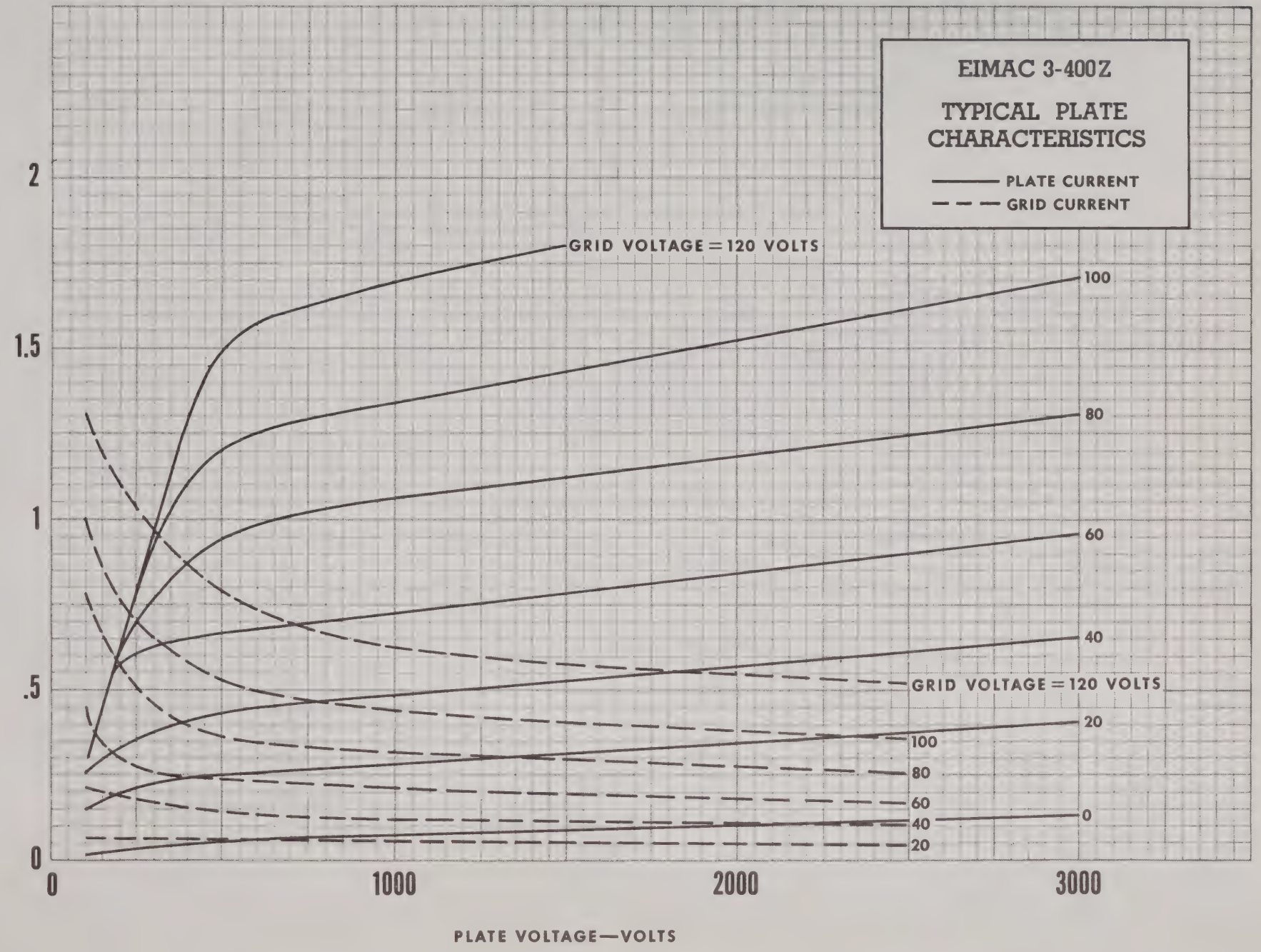


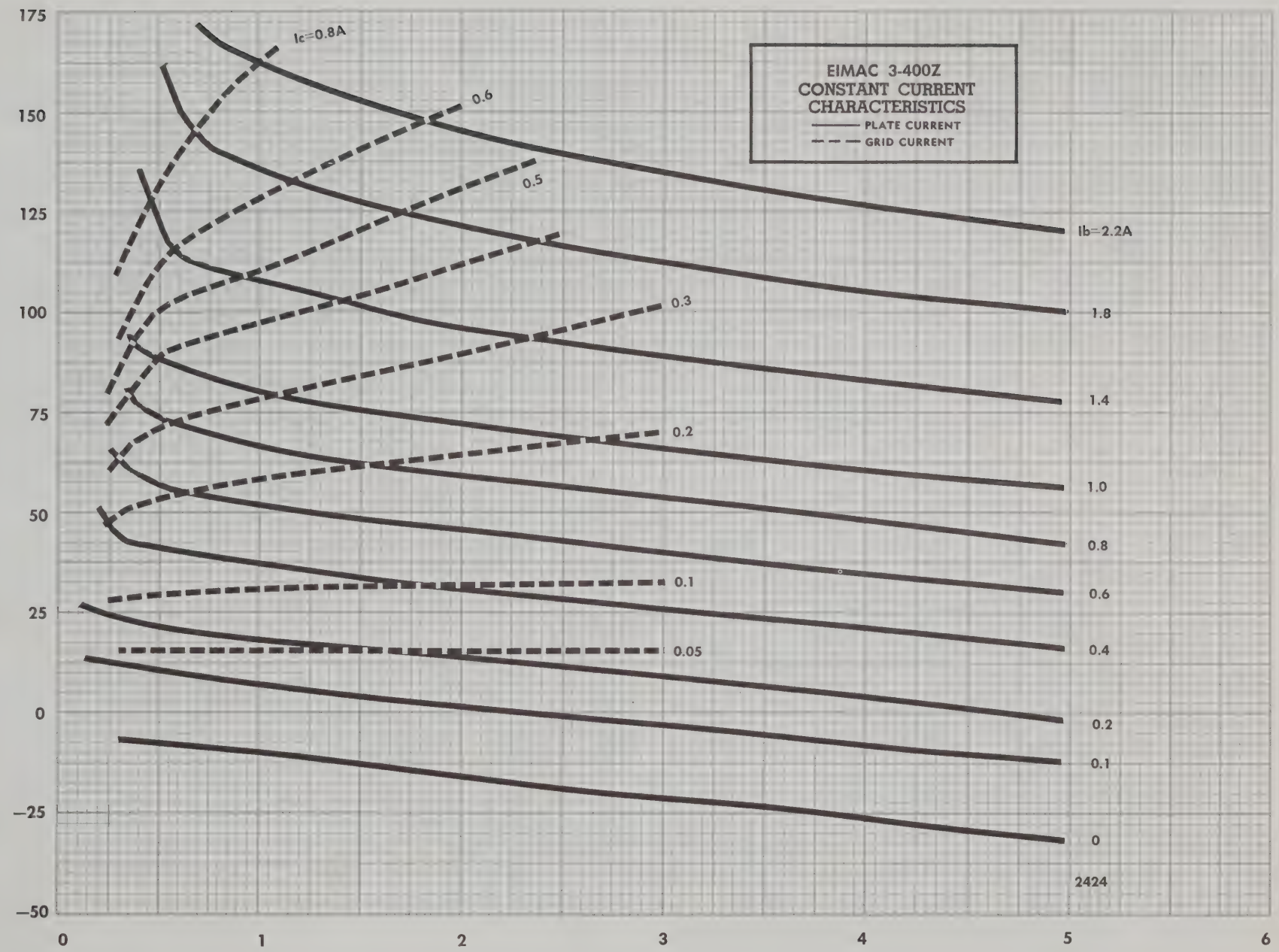
NOTE:
BASE PINS (N) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA'S. OF .204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMS. (L) & (M).

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4-3/4	5-1/4	
B		3-9/16 D.	
D	.745 D.	.755 D.	
E	.640	.660	
F	3-15/16	4-7/16	
H	9/16	11/16	
J		2-1/2 D.	
K			13/16
L			60° TYP.
M			1-1/4 D. P.C.
N	.185 D.	.191 D.	
P	1/2	5/8	


EIMAC 3-400Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED — GRID
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
FILAMENT-TO-GRID VOLTAGE — VOLTS
PLATE-TO-GRID VOLTAGE — VOLTS
−175
−150
−125
−100
−75
−50
−25
0
+25
0
1000
2000
3000
4000
5000
.600
.400
.200
.100
.050
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0


EIMAC 3-400Z
TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
0
GRID VOLTAGE = 120 VOLTS
100
80
60
40
20
CURRENT—AMPERES
2
1.5
1
.5
0
0
1000
2000
3000
PLATE VOLTAGE—VOLTS


EIMAC 3-400Z
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
Ic=0.8A
0.6
0.5
0.3
0.2
0.1
0.05
Ib=2.2A
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0
2424
175
150
125
100
75
50
25
0
−25
−50
0
1
2
3
4
5
6
Ec/VOLTS
Eb/KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8159

3CX10,000A3

MEDIUM-MU POWER TRIODE

The EIMAC 3CX10,000A3 is a ceramic and metal power triode intended primarily for use as a power oscillator in industrial-heating applications. It is also recommended for use as a grounded-grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		V
Current	94		104	A
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Input	48		58	pF
Output	1.2		1.5	pF
Feedback	30		38	pF
Frequency for Maximum Ratings				140 MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1300
Recommended Chimney	EIMAC SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	8.5 in
Diameter	7.0 in
Net Weight	12 lb

R-F INDUSTRIAL OSCILLATOR
CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	4.0	AMPS
PLATE DISSIPATION	10	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION, Optimum Load

D-C Plate Voltage	6000	7000	volts
D-C Grid Voltage	-575	-670	volts
D-C Plate Current	4.0	4.0	amps
D-C Grid Current	610	670	mA
Plate Input Power	24	28	kW
Plate Output Power	18.9	22.4	kW

R-F POWER AMPLIFIER
GROUNDED-GRID, CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	4.0	AMPS
PLATE DISSIPATION	10	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000	volts
D-C Grid Voltage	-535	-625	volts
D-C Plate Current	4.0	4.0	amps
D-C Grid Current	545	530	mA
Driving Power	3700	4100	watts
Plate Output Power	20.5	24.5	kW

(Effective 5-1-68) © 1961, 1964, 1968 by Varian Printed in U.S.A.

R-F POWER AMPLIFIER
PLATE-MODULATED, CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5500	VOLTS
D-C PLATE CURRENT	3.0	AMPS
PLATE DISSIPATION	6.5	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	4000	5000	volts
D-C Grid Voltage	-480	-600	volts
D-C Plate Current	3.0	3.0	amps
D-C Grid Current	660	550	mA
Driving Power	530	515	watts
Plate Output Power	9.7	12.4	kW

R-F LINEAR AMPLIFIER
GROUNDED-GRID, CLASS-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	12	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000	volts
Zero-Sig Grid Voltage*	-270	-325	volts
Max-Sig D-C Plate Current	4.0	4.0	amps
Max-Sig D-C Grid Current	300	250	mA
Driving Power	1900	2050	watts
Plate Output Power	18	20	kW

*Adjust to give 500 milliamperes zero-signal d-c plate current.

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristics curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

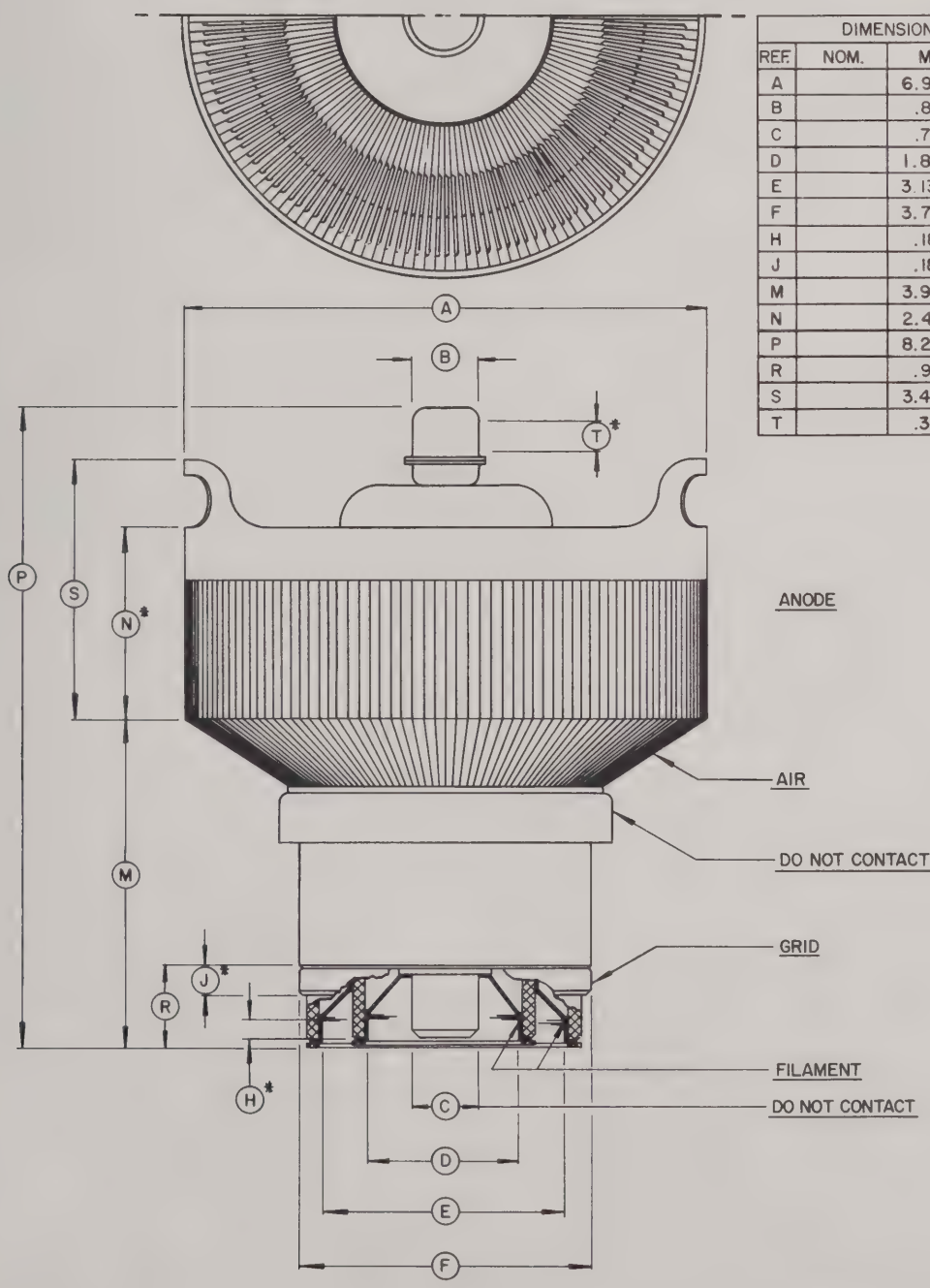
Cooling - The maximum temperature rating for the external surfaces of the 3CX10,000A3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

	Sea Level		10,000 Feet	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	110	.25	160	.36
6000	180	.53	260	.78
8000	270	.95	390	1.4
10,000	373	1.55	545	2.25
12,000	448	2.00	650	2.9

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 250 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

Filament Operation - The rated filament voltage for the 3CX10,000A3 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than five percent.

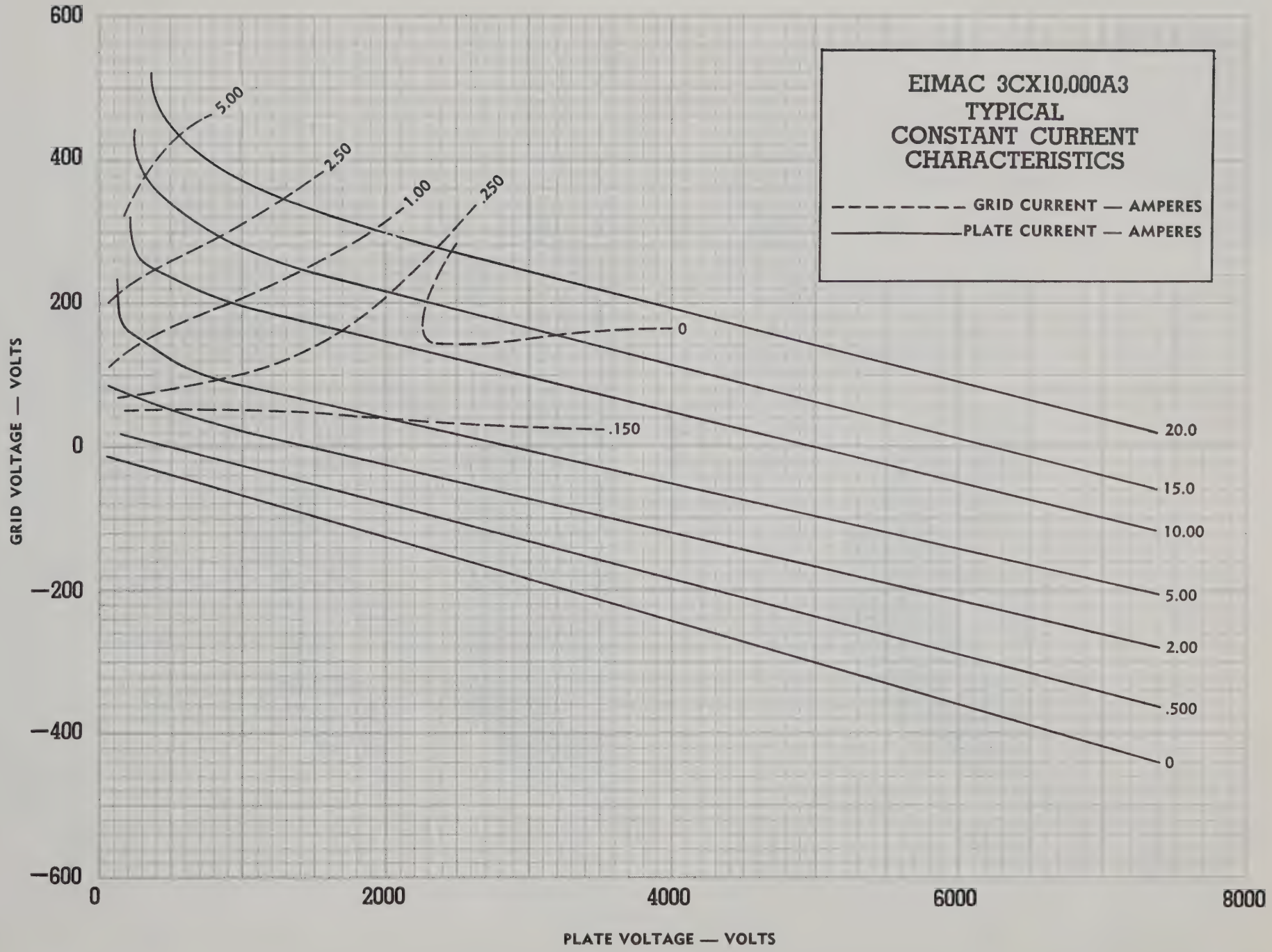
Special Applications - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	

*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

▶ Indicates change from sheet dated 7-1-61


EIMAC 3CX10,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
600
400
200
0
−200
−400
−600
0
2000
4000
6000
8000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
5.00
2.50
1.00
.250
0
.150
20.0
15.0
10.00
5.00
2.00
.500
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

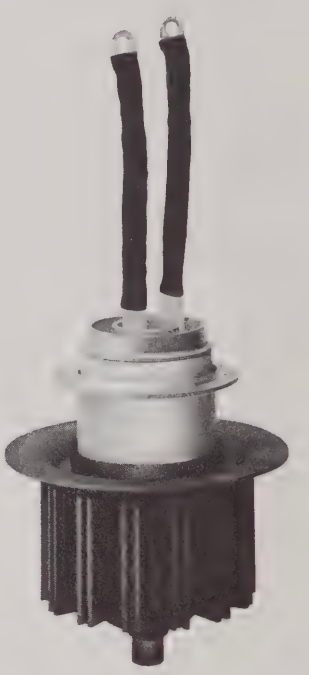
3CV30,000H3

MEDIUM-MU VAPOR-COOLED POWER TRIODE

The EIMAC 3CV30,000H3 is a vapor-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating service. Its vapor-cooled anode is conservatively rated at 30 kilowatts of plate dissipation when mounted in an EIMAC BR-200 boiler.

Full input of 60 kilowatts is permissible up to 100 megahertz. Large reserve emission is available from its one kilowatt filament and the grid structure is rated at one ampere making this tube an excellent choice for severe applications.

It is also recommended as an audio amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		V
Current	152		172	A
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF
Frequency for Maximum Ratings			100	MHz

MECHANICAL

Filament Connections	Flexible Leads
Grid Connection	Terminal Ring
Recommended Boiler	EIMAC BR-200
Operating Position	Vertical, Base up
Cooling	Vapor and Forced air
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Maximum Dimensions:	See Outline
Net Weight	18 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
DC GRID CURRENT	1.0	AMPS
PLATE INPUT POWER	60	KW
PLATE DISSIPATION	30	KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Plate Current	6.0	6.0	amps
DC Grid Voltage	-600	-800	volts
DC Grid Current	.66	.315	amps
Peak Positive Grid Voltage	440	360	volts
Driving Power	660	365	watts
Plate Input Power	42	60	kW
Plate Dissipation	12	18	kW
Plate Output Power	30	42	kW
Approximate Load Impedance	600	750	ohms

 © 1968 Varian Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER

PLATE-MODULATED

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	20	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	-600	-820	volts
DC Plate Current	5.0	5.0	amps
DC Grid Current	600	600	mA
Driving Power	600	750	watts
Plate Output Power	17.8	27.5	kW

AUDIO AMPLIFIER

OR MODULATOR

Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
PLATE DISSIPATION	30	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (two tubes)

DC Plate Voltage	6000	9600	volts
DC Grid Voltage*	-280	-480	volts
Zero-Sig Plate Current	.5	.25	amps
Max-Sig DC Plate Current	4.2	3.1	amps
Max-Sig DC Grid Current	145	42	mA
Peak Driving Voltage	480	590	volts
Drive Power	140	50	watts
Plate-to-Plate Load Resistance	1300	2740	ohms
Power Output	31	36	kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament The rated filament voltage for the 3CV30,000H3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation The maximum plate input power rating is 60 kilowatts at 10,000 volts and 6.0 amperes dc. This rating applies for Class C amplifier or oscillator service and for Class AB applications. When used as a plate modulated rf amplifier, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition, current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

Special Application If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

MECHANICAL

Mounting The 3CV30,000H3 must be mounted vertically, base up in an EIMAC BR-200 boiler. It is very important that the boiler tube assembly be mounted vertically, the water be maintained at the suggested level, and that the flange of the tube makes a vapor-tight seal against the rubber "O" ring and boiler.

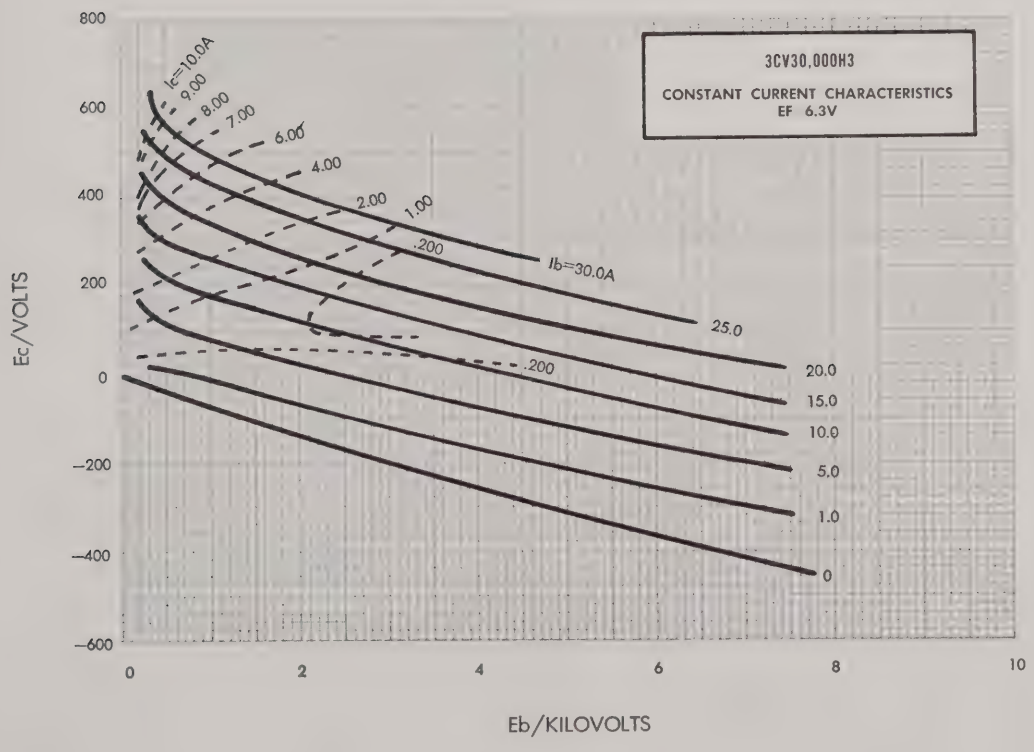
Cooling Cooling is accomplished by immersion of the anode in a distilled water-filled BR-200 boiler. The energy dissipated at the anode causes the water to boil and be converted into steam. Steam is carried away by convection to the condenser where it is cooled and condenses into water. Condensate is then returned to the boiler.

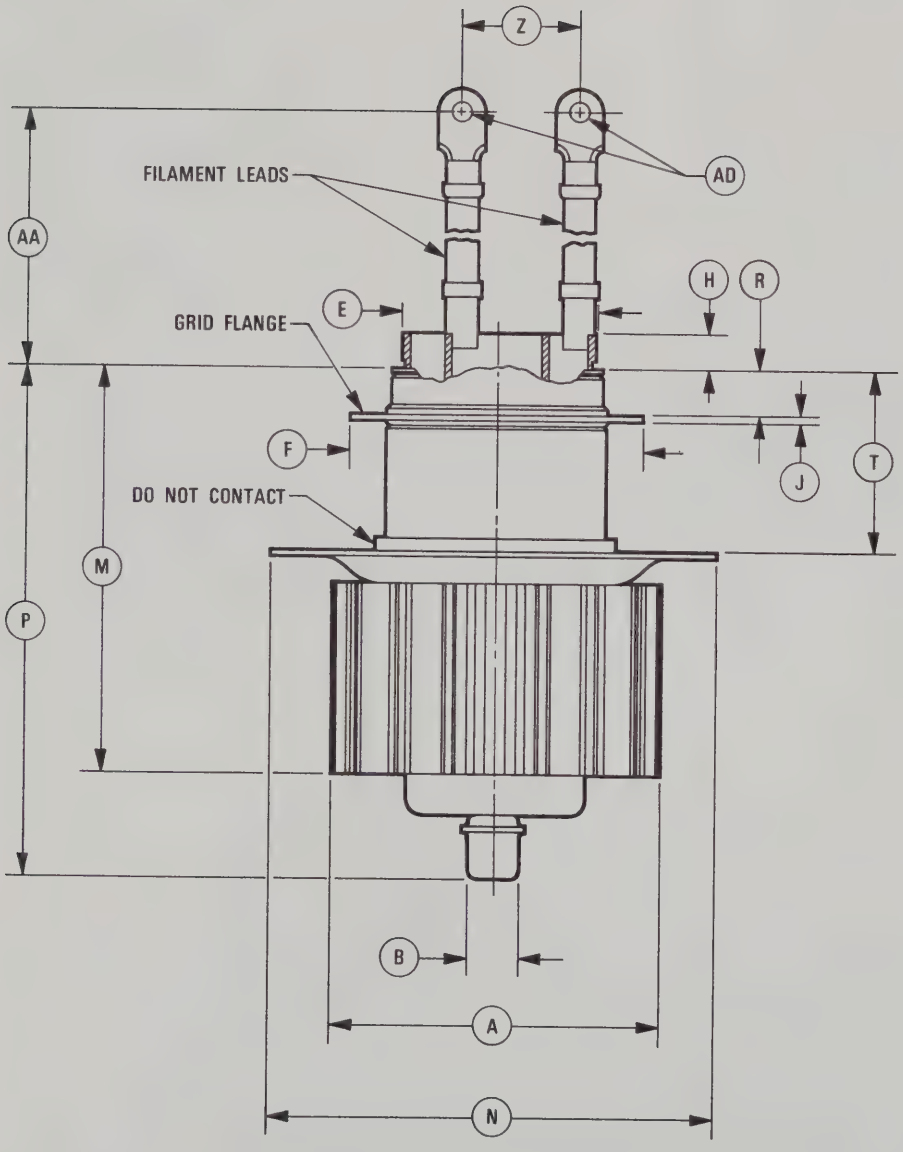
The boiling action maintains the anode surface temperature at approximately 100°C. In a properly designed system (such as the 3CV30,000H3 and BR-200) it is unlikely that anode surface temperature will ever exceed 125°C — well below the rated maximum for the tube — even at full plate dissipation levels.

The water in the boiler must be maintained at a constant level, just below the top of the anode fins. This level is marked on the boiler. A recommended system for assuring constant water level is shown in the system diagram below. This system incorporates an EIMAC CB-202 Control Box to sense water level and a small reservoir to supply make-up water on demand. In the event of a drop in system water level, a switch is closed in the control box, energizing a solenoid water valve in the line from the reservoir. When the make-up water brings the system back to the proper level, the switch is opened, de-energizing the solenoid valve. A second switch in the CB-202 Control Box senses a lower, danger level and can be used to actuate an alarm or shut down the system.

For reliable operation, it is essential that the Control Box be mounted so that the level sensed is the actual level in the boiler.

Separate cooling of the tube base is required and is accomplished by directing 100 CFM of cooling air into the base structure from the top of the socket.

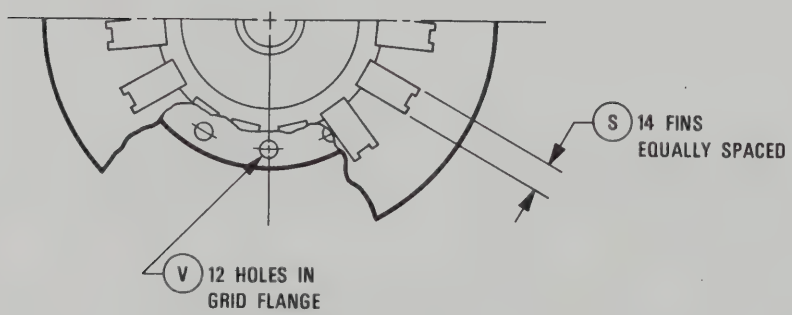




DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A			5.812
B	.855	.895	
E	3.230	3.270	
F	5.030	5.090	
H	.530	.700	
J			.125
M	6.643	6.775	
N			7.750
P	8.400	8.625	
R	.700	.860	
S			.510
T			2.806
V			.265
Z			2.000
AA	8.500	9.000	
AD			.390

NOTE:
REF. DIMS. ARE FOR INFO. ONLY &
ARE NOT REQ'D. FOR INSP. PURPOSES.



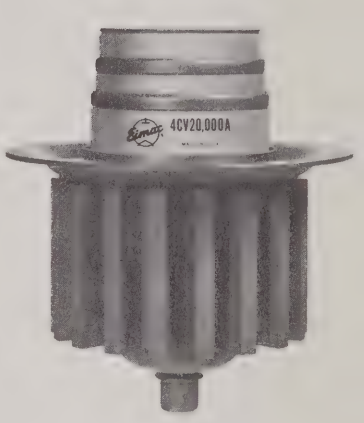
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CV20,000A

VAPOR-COOLED
RADIAL-BEAM
POWER-TETRODE

The Eimac 4CV20,000A is a vapor-cooled, ceramic-metal, power tetrode designed for use as an oscillator, modulator, or amplifier in audio and radio-frequency applications. The vapor-cooled anode is conservatively rated at 20 kilowatts of plate dissipation when mounted in an Eimac BR-200 boiler.

A pair of these tubes in class AB_1 audio frequency or radio frequency linear amplifier service will deliver 35 kilowatts output. The frequency for maximum ratings is 30 megacycles; operation to 110 megacycles is possible at reduced input.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		V
Current	73		78	A
Amplification Factor (Grid-Screen)		4.5		
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	pF
Output	18		23	pF
Feedback			1.0	pF
Direct Interelectrode Capacitances, Grounded Grid:				
Input	48		58	pF
Output	18		23	pF
Feedback			1.0	pF
Frequency for Maximum Ratings			30	MHz

MECHANICAL

Base	Special, Concentric
Recommended Socket	Eimac, SK-300A
Recommended Boiler	Eimac, BR-200
Operating Position	Axis vertical, base up
Cooling	Vapor & Forced air
Maximum Seal Temperature	250° C
Maximum Anode Core Temperature	250° C
Maximum Over-all Dimensions:	
Height	9.13 in
Diameter	7.75 in
Net Weight	21 lbs

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

DC PLATE VOLTAGE (to 30 Mc)	7500 VOLTS
(30-60 Mc)	7000 VOLTS
(60-110 Mc)	6500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT (to 30 Mc)	3.0 AMPS
(30-60 Mc)	2.8 AMPS
(60-110 Mc)	2.6 AMPS
PLATE DISSIPATION	20,000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Below 30 Mc)

DC Plate Voltage	6000	7500 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	-290	-300 volts
DC Plate Current	3.0	3.0 amps
DC Screen Current*	500	500 mA
DC Grid Current	290	290 mA
Peak RF Grid Voltage*	520	530 volts
Driving Power	150	155 watts
Plate Output Power	12,900	17,000 watts

*Approximate Values

(Effective 6-1-68) © 1962, 1968 by Varian

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION*	13,500 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

* Corresponds to 20,000 watts at 100-percent sine-wave modulation.

** Approximate values.

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	4000	5000	volts
DC Screen Voltage	500	500	volts
Peak AF Screen Voltage (For 100% modulation)	470	490	volts
DC Grid Voltage	-320	-340	volts
DC Plate Current	2.2	2.2	amps
DC Screen Current**	335	330	mA
DC Grid Current**	160	150	mA
Peak RF Grid Voltage**	490	510	volts
Grid Driving Power	78.5	76.5	watts
Plate Dissipation	3050	3250	watts
Plate Output Power	5750	7750	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	20,000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

* Per Tube

**Approximate values.

TYPICAL OPERATION (Peak-Envelope or Modulation-Crest Conditions.

DC Plate Voltage	5000	7500	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-250	-260	volts
Max-Signal Plate Current	4.0	4.0	amps
Zero-Signal Plate Current	2.0	2.0	amps
Max-Signal Screen Current*	165	150	mA
Peak RF Grid Voltage*	240	250	volts
Driving Power	0	0	watts
Plate Dissipation	9700	12,500	watts
Plate Output Power	10,300	17,500	watts
Resonant Load Impedance	590	1030	ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	20,000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

* Approximate values

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	5000	7500	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-250	-260	volts
Max-Signal Plate Current	8.0	8.0	amps
Zero-Signal Plate Current	4.0	4.0	amps
Max-Signal Screen Current**	330	300	mA
Peak RF Driving Voltage**	240	250	volts
Driving Power	0	0	watts
Load Resistance, Plate-to-Plate	1180	2060	ohms
Max-Signal Plate Dissipation*	9700	12,500	watts
Max-Signal Plate Output Power	20,600	35,000	watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CV20,000A must be operated with its axis vertical, base up in an Eimac BR-200 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the rubber "O" ring and boiler. A typical vapor cooling system is shown below.

SOCKET — The Eimac SK-300A socket is available for use with the 4CV20,000A. Filament, control grid and screen grid connections are made to this socket.

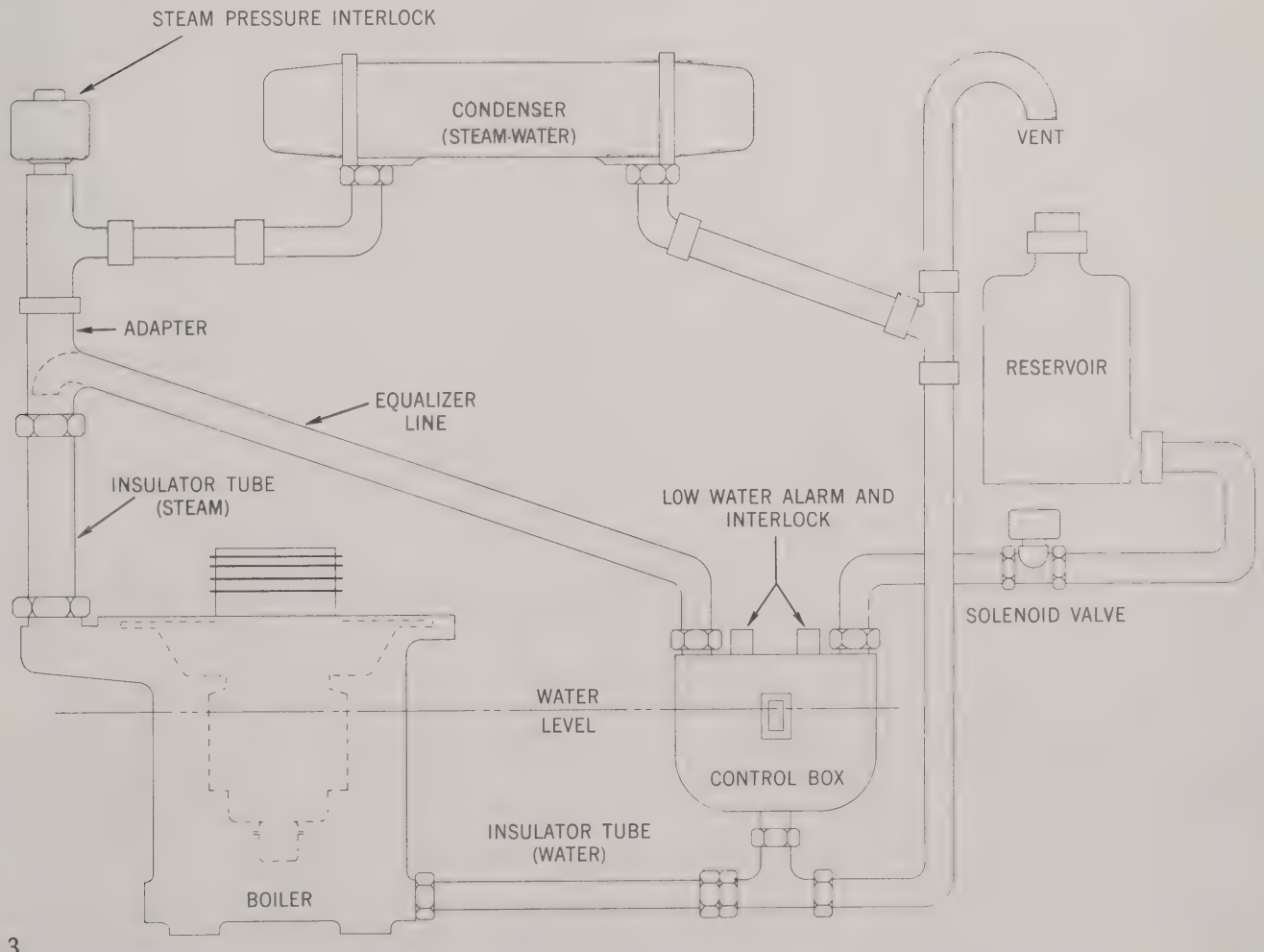
COOLING — Cooling is accomplished by immersing the anode in the distilled water filled BR-200 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system (such as the 4CV20,000A and BR-200), it is extremely unlikely that the anode surfaces will ever exceed 110°C - well below the 250°C maximum rating - at full dissipation ratings.

The water in the boiler must be maintained at a constant level as indicated by the mark on the boiler, just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any losses or drops in liquid level are sensed by the control box, CB-202. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-energizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Cooling of the tube base is accomplished by blowing 25-50 CFM of air into the socket in the area of the filament seals.

VAPOR COOLING SYSTEM



ELECTRICAL

FILAMENT OPERATION — The rated filament voltage for the 4CV20,000A is 7.5 volts. Filament voltage, as measured at the socket, must be maintained at 7.5 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

CONTROL-GRID OPERATION — The 4CV20,000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

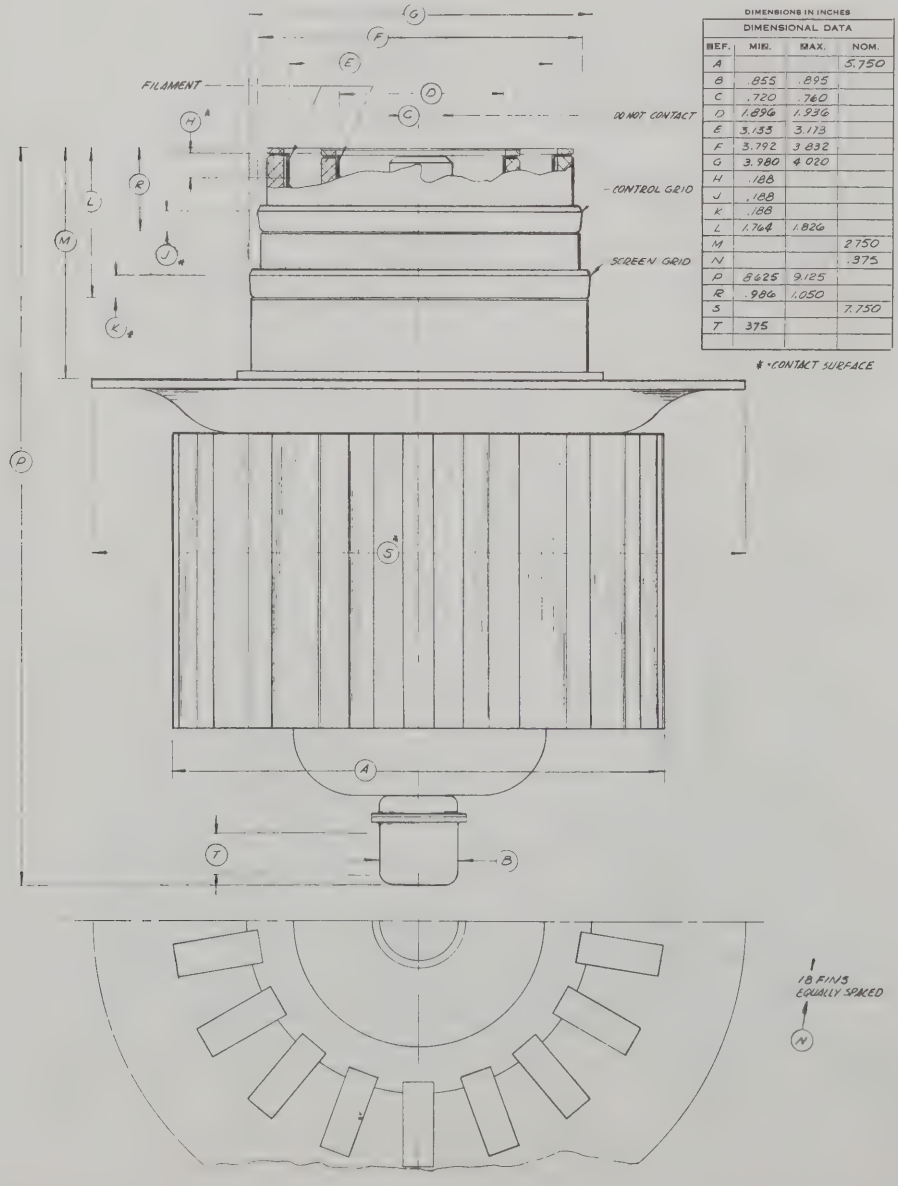
SCREEN-GRID OPERATION — The power dissipated by the screen must not exceed 250 watts. Screen dissipation, in cases where no ac is applied to the screen is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

PLATE DISSIPATION — The plate dissipation rating of 20,000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

When the 4CV20,000A is used as a plate-modulated rf amplifier, this rating is reduced to 13,500 watts with a reduced plate input rating of 5000 volts and 2.5 amps.

SPECIAL APPLICATIONS — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing Department, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California for information and recommendations.

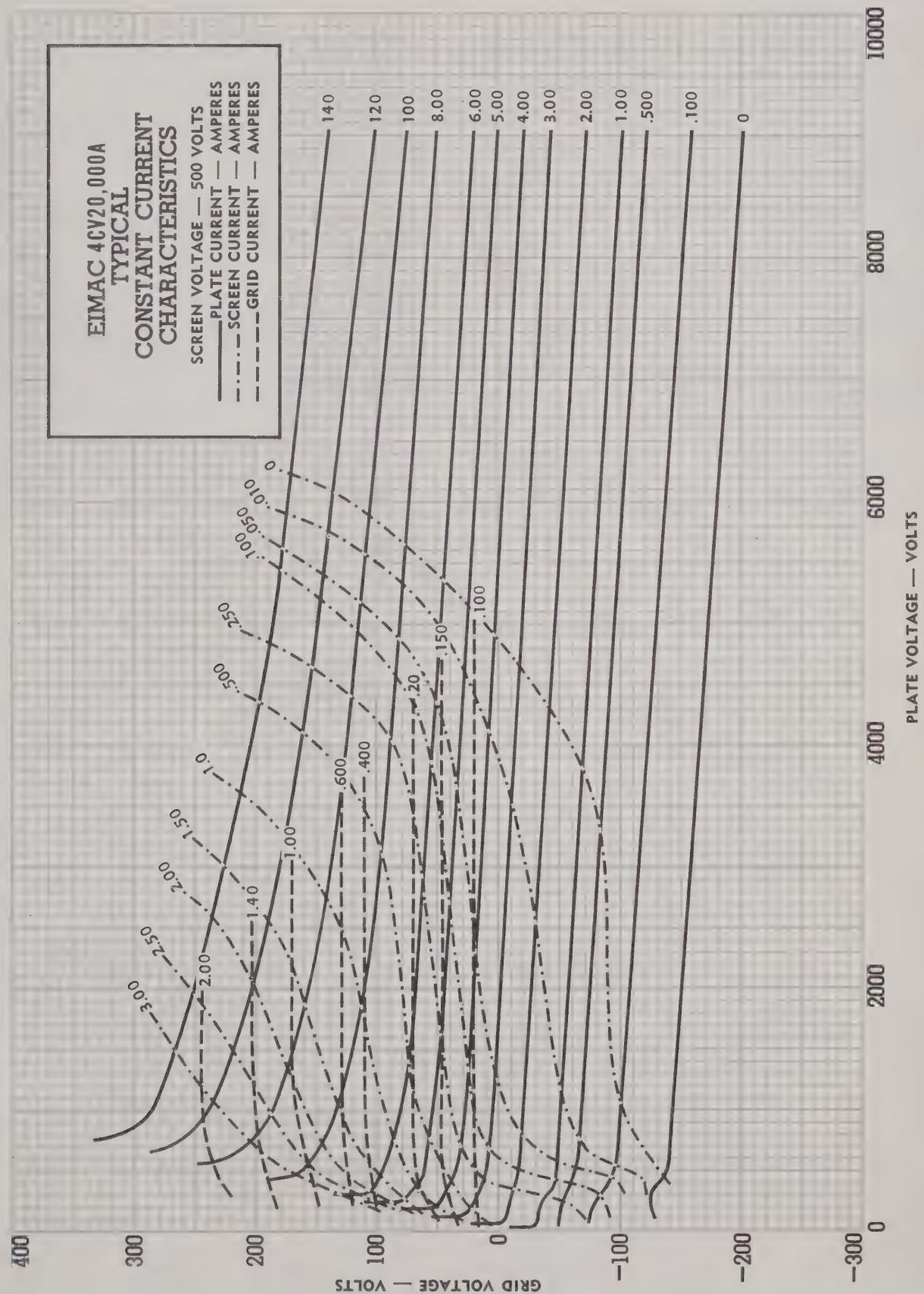


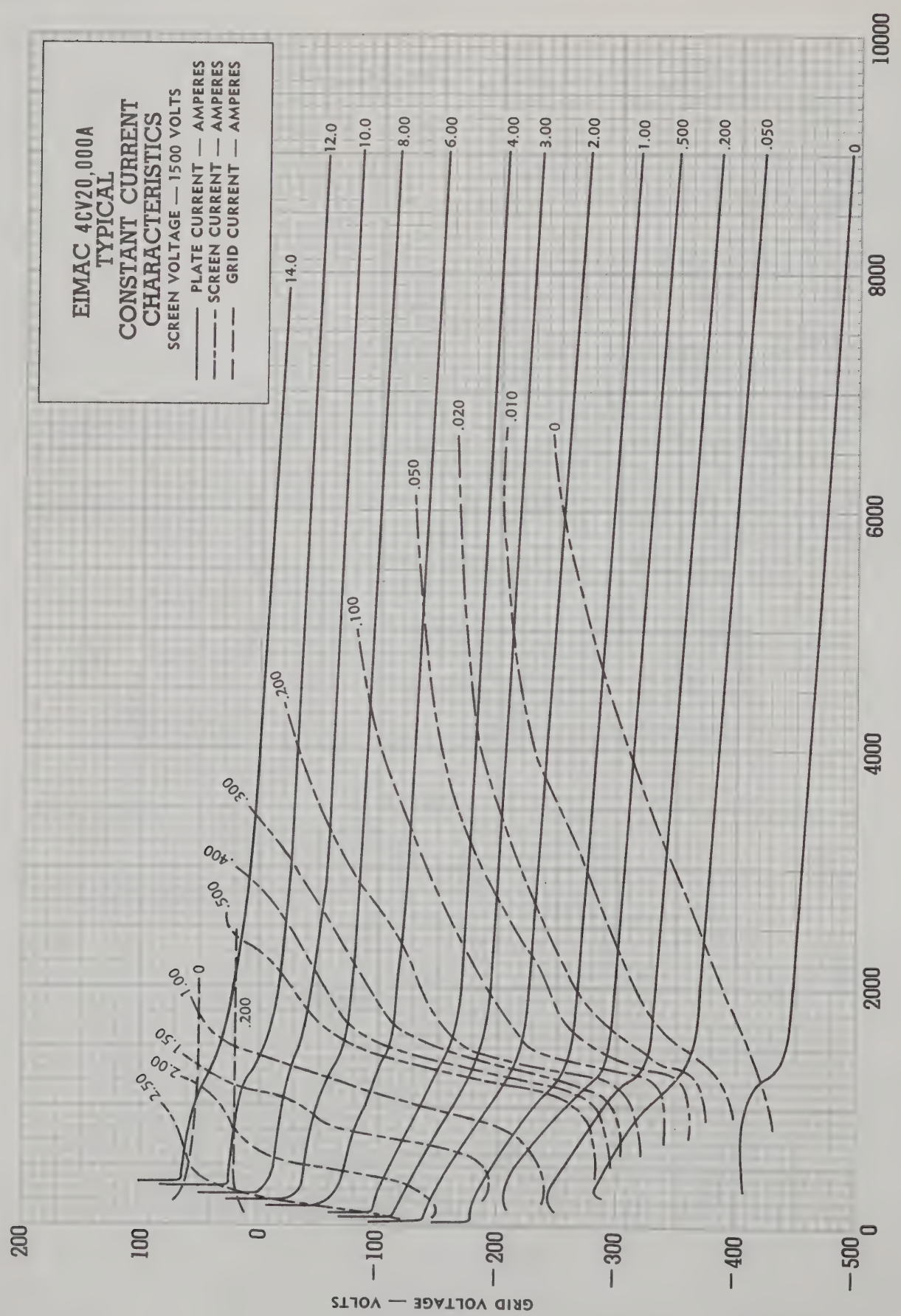
DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A			5.750
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
G	3.980	4.020	
H	.188		
J	.188		
K	.188		
L	1.764	1.826	
M			2.750
N			.375
P	8.625	9.125	
R	.986	1.050	
S			7.750
T	.375		

CONTACT SURFACE


EIMAC 4CV20,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
140
120
100
8.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.100
0
.010
.050
.100
.250
.500
1.0
1.50
2.00
2.50
3.00
1.40
.600
.400
.20
.150
.100
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS


EIMAC 4CV20,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14.0
12.0
10.0
8.00
6.00
4.00
3.00
2.00
1.00
.500
.200
.050
0
.020
.010
.100
.200
.300
.400
.500
0
1.00
.200
1.50
2.00
2.50
200
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8245
4CX250K

8246
4CX250M

RADIAL-BEAM POWER TETRODE

The 8245/4CX250K and 8246/4CX250M are compact, forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 8245/4CX250K is designed to operate with a heater voltage of 6.0 volts, while the 8246/4CX-250M is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

These tubes are of coaxial construction and are especially designed for cavity operation.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential					
	Heating Time	30	60		s
	Cathode-to-heater Potential			±150	V
Heater:	Voltage 4CX250K		6.0		V
	Current 4CX250K	2.30		3.0	A
	Voltage 4CX250M		26.5		V
	Current 4CX250M	0.35		0.68	A
Amplification Factor (Grid-to-Screen)			5		
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	25.0		29.0	pF
	Output	4.2		5.2	pF
	Feedback			0.05	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.	
Input	14.5	19	pF
Output	4.2	5.2	pF
Feedback		0.01	pF
Frequency for Maximum Ratings (CW)		500	MHz
(Pulsed)		1500	MHz

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Ceramic-to-Metal-Seals	250° C
Anode Core	250° C
Operating Position	Any
Maximum Dimensions:	
Height	2.813 in
Diameter	1.640 in
Cooling	Forced Air
Net Weight	4.6 oz
Shipping Weight (Approximate)	1.6 lbs

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)
MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

	Frequencies up to 175 MHz				500 MHz	
DC Plate Voltage	500	1000	1500	2000	2000	volts
DC Screen Voltage	250	250	250	250	300	volts
DC Grid Voltage	-90	-90	-90	-90	-90	volts
DC Plate Current	250	250	250	250	250	mA
DC Screen Current*	45	38	21	19	10**	mA
DC Grid Current*	35	31	28	26	25**	mA
Peak RF Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**	watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

* Approximate values.

** Measured Values for a typical cavity amplifier circuit.

(Effective 5-1-68) © 1959, 1962, 1963, 1968 by Varian

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz)

DC Plate Voltage	500	1000	1500	volts
DC Screen Voltage	250	250	250	volts
DC Grid Voltage	-100	-100	-100	volts
DC Plate Current	200	200	200	mA
DC Screen Current*	31	22	20	mA
DC Grid Current*	15	14	14	mA
Peak RF Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

* Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT (AVERAGE)	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 216 MHz, 5 MHz bandwidth)

DC Plate Voltage	750	1000	2000	volts
DC Screen Voltage	300	300	350	volts
DC Grid Voltage	-60	-65	-70	volts
During Sync-Pulse Peak:				
DC Plate Current	335	330	360	mA
DC Screen Current	50	45	29	mA
DC Grid Current	15	20	25	mA
Peak RF Grid Voltage	85	95	100	volts
RF Driver Power (approx.)	7	8	9	watts
Useful Power Output	135	200	440	watts
Black Level:				
DC Plate Current	245	240	250	mA
DC Screen Current	20	15	0	mA
DC Grid Current	4	4	4	mA
Peak RF Grid Voltage (approx.)	65	70	75	volts
RF Driver Power (approx.)	4.25	4.7	5.5	watts
Plate Power Input	185	240	500	watts
Useful Power Output	75	110	250	watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 VOLTS
PULSED SCREEN VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	-500 VOLTS
MAXIMUM PULSE DURATION	5 μS
PULSED CATHODE CURRENT	7 AMPS
AVERAGE POWER INPUT	250 WATTS
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200 MHz

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Current	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	-200	-250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 μsec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage*	-55	-55	-55	volts
Zero-Signal DC Plate Current	100	100	100	mA
Peak RF Grid Voltage**	50	50	50	volts
DC Plate Current	250	250	250	mA
DC Screen Current**	10	8	5	mA
Plate Input Power	250	375	500	watts
Plate Output Power	120	215	300	watts
Two-Tone Average DC Plate Current	190	190	190	mA
Two-Tone Average DC Screen Current**	2	-1	-2	mA

* Approximate values.

** Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direst tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this proceedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting The 4CX250K and 4CX250M may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures below 250° C. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals.

The table below lists the minimum cooling requirements at sea level with 50° C ambient air to maintain 225° C on the anode. For operation at 10,000 feet, the air-flow values should be multiplied by 1.46.

	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	Air Flow (CFM)	Static Pressure (inches of water)	Air Flow (CFM)	Static Pressure (inches of water)
150	3.5	0.3	3.1	0.2
200	4.3	0.4	4.6	0.4
250	5.5	0.7	6.1	0.7

ELECTRICAL

Heater The rated heater voltages for the 4CX-250K and 4CX250M are 6.0 and 26.5 volts, respectively and should be maintained at these values plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 500 MHz.

Frequency, MHz	4CX250K	4CX250M
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz, drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250K or 4CX250M.

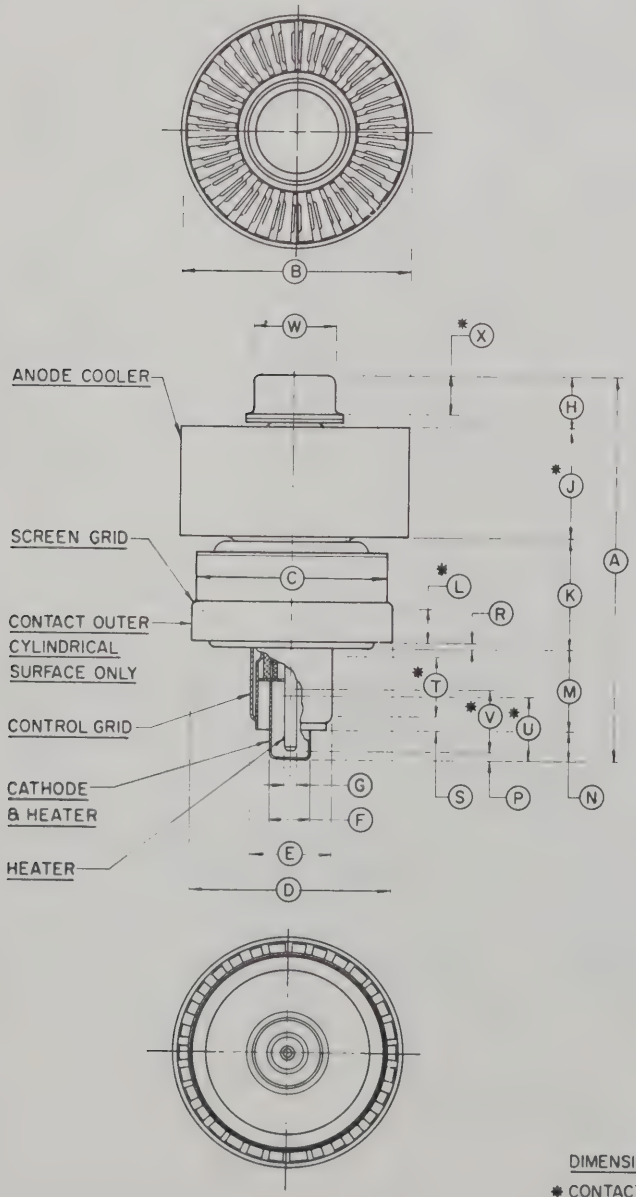
Plate Operation The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

UHF Operation The 4CX250K and 4CX250M are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

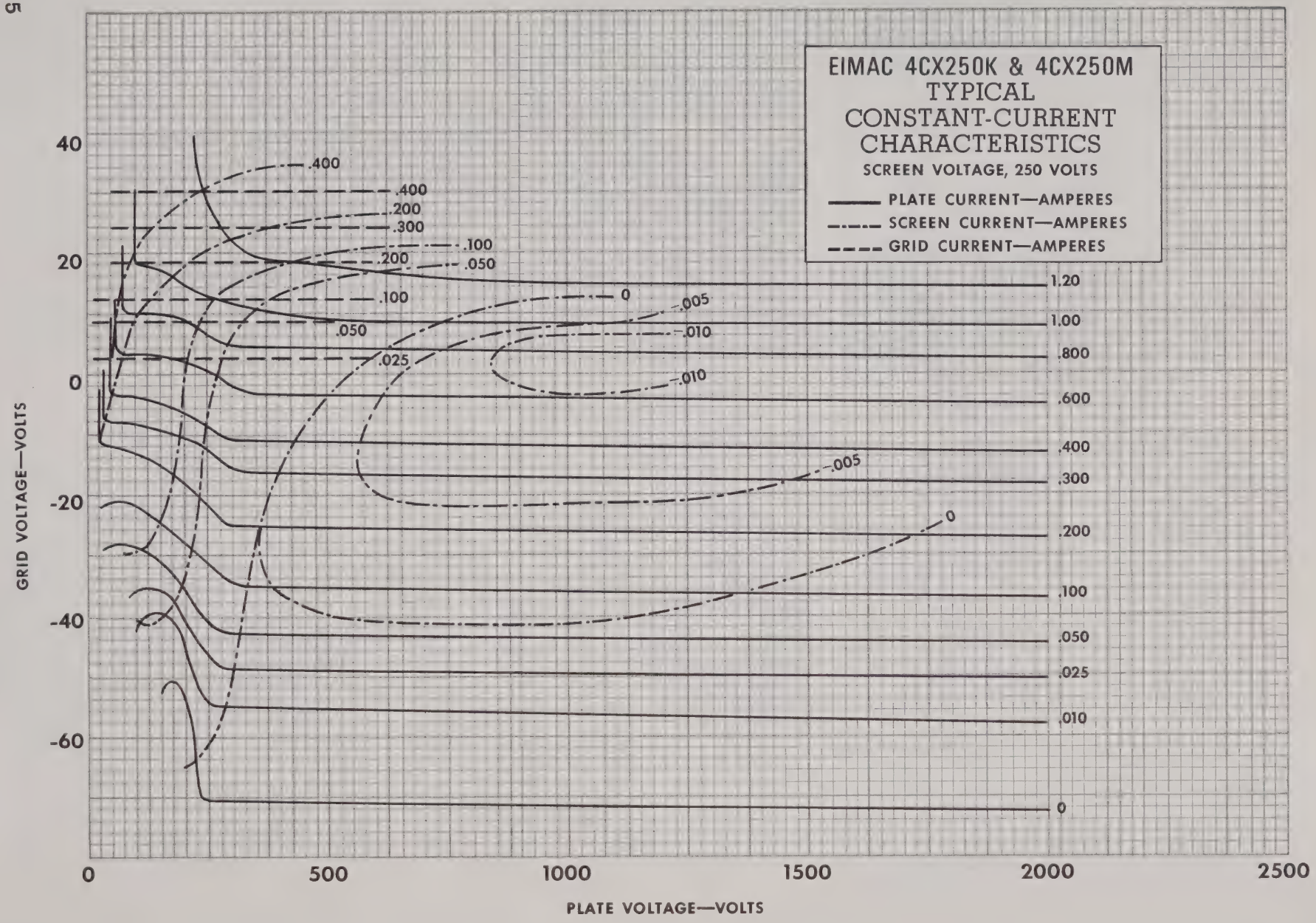
Special Applications If it is desired to operate these tubes under conditions widely different from those given here, write to Product Manager, Eimac Division of Varian, San Carlos, California, for information and recommendations.

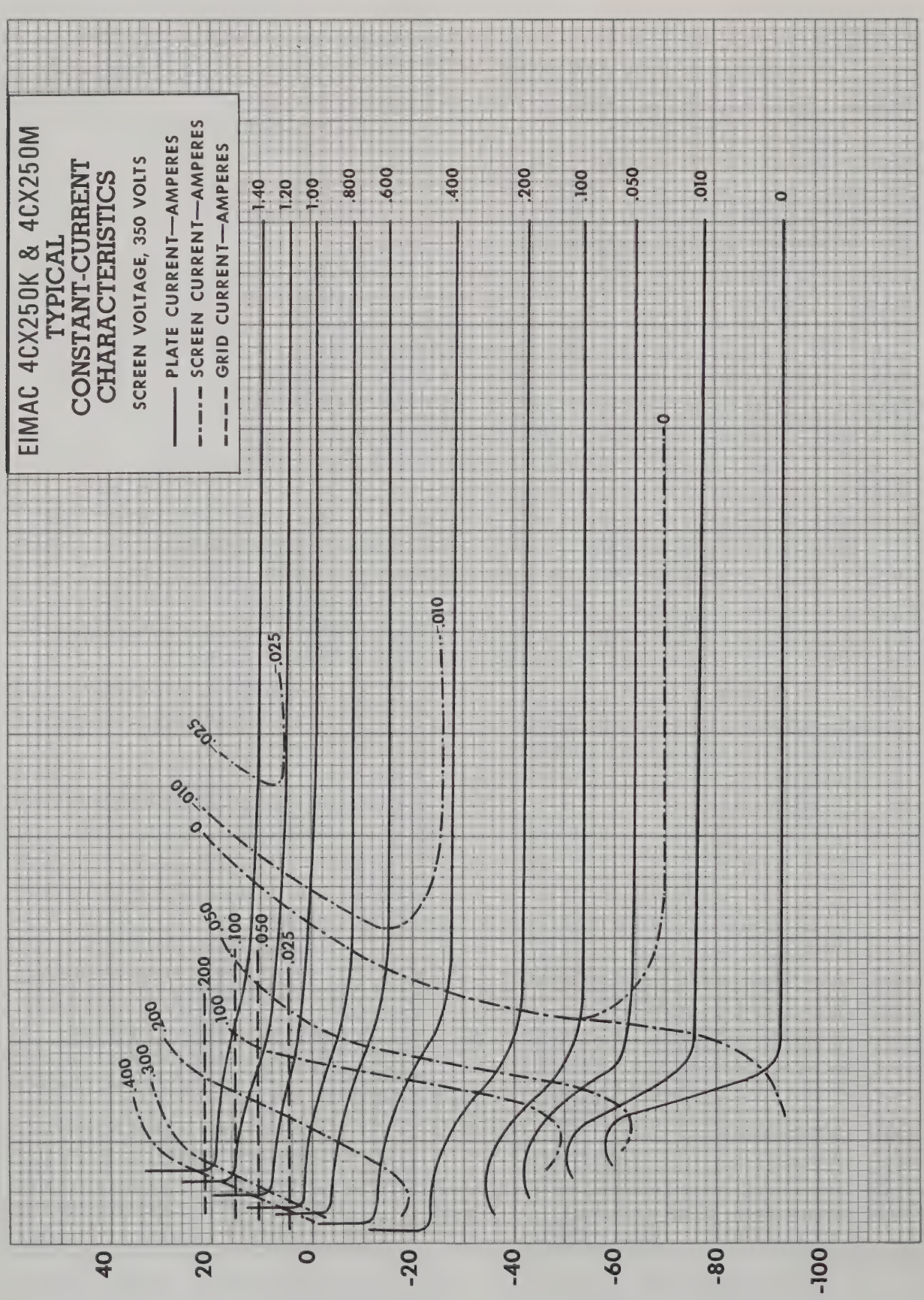


DIMENSIONS		
REF.	MIN.	MAX.
A		2.813
B	1.610 DIA.	1.640 DIA.
C		1.406 DIA.
D	1.410 DIA.	1.440 DIA.
E	.587 DIA.	.597 DIA.
F	.317 DIA.	.327 DIA.
G	.088 DIA.	.098 DIA.
H		.358
J	.710	.790
K	.740	.820
L	.187	
M	.500	.580
N	.235	.265
P	.032	.062
R	.020 NOM.	
S	.125 NOM.	
T	11/32	
U	13/32	
V	15/32	
W	.559	.573
X	.240	.280

DIMENSIONS IN INCHES

* CONTACT SURFACE


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.010
.005
0
.400
.400
.200
.300
.100
.200
.050
.100
.050
.025


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.025
.050
.100
.200
.400
.300
.200
.100
.050
.025
0
.010
.025
.010
0
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
PLATE VOLTAGE—VOLTS
GRID VOLTAGE—VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8245
4CX250K
8246
4CX250M

RADIAL-BEAM
POWER TETRODE

The 8245/4CX250K and 8246/4CX250M are compact, forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 8245/4CX250K is designed to operate with a heater voltage of 6.0 volts, while the 8246/4CX-250M is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

These tubes are of coaxial construction and are especially designed for cavity operation.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential					
	Heating Time	30	60		s
	Cathode-to-heater Potential			±150	V
Heater:	Voltage 4CX250K		6.0		V
	Current 4CX250K	2.30		3.0	A
	Voltage 4CX250M		26.5		V
	Current 4CX250M	0.35		0.68	A
Amplification Factor (Grid-to-Screen)			5		
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	25.0		29.0	pF
	Output	4.2		5.2	pF
	Feedback			0.05	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.	
Input	14.5	19	pF
Output	4.2	5.2	pF
Feedback		0.01	pF
Frequency for Maximum Ratings (CW)		500	MHz
(Pulsed)		1500	MHz

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Ceramic-to-Metal-Seals	250° C
Anode Core	250° C
Operating Position	Any
Maximum Dimensions:	
Height	2.813 in
Diameter	1.640 in
Cooling	Forced Air
Net Weight	4.6 oz
Shipping Weight (Approximate)	1.6 lbs

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)
MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

	Frequencies up to 175 MHz				500 MHz	
DC Plate Voltage	500	1000	1500	2000	2000	volts
DC Screen Voltage	250	250	250	250	300	volts
DC Grid Voltage	-90	-90	-90	-90	-90	volts
DC Plate Current	250	250	250	250	250	mA
DC Screen Current*	45	38	21	19	10**	mA
DC Grid Current*	35	31	28	26	25**	mA
Peak RF Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**	watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

* Approximate values.

** Measured Values for a typical cavity amplifier circuit.

(Effective 5-1-68) © 1959, 1962, 1963, 1968 by Varian

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz)

DC Plate Voltage	500	1000	1500	volts
DC Screen Voltage	250	250	250	volts
DC Grid Voltage	-100	-100	-100	volts
DC Plate Current	200	200	200	mA
DC Screen Current*	31	22	20	mA
DC Grid Current*	15	14	14	mA
Peak RF Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

* Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT (AVERAGE)	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 216 MHz, 5 MHz bandwidth)

DC Plate Voltage	750	1000	2000	volts
DC Screen Voltage	300	300	350	volts
DC Grid Voltage	-60	-65	-70	volts
During Sync-Pulse Peak:				
DC Plate Current	335	330	360	mA
DC Screen Current	50	45	29	mA
DC Grid Current	15	20	25	mA
Peak RF Grid Voltage	85	95	100	volts
RF Driver Power (approx.)	7	8	9	watts
Useful Power Output	135	200	440	watts
Black Level:				
DC Plate Current	245	240	250	mA
DC Screen Current	20	15	0	mA
DC Grid Current	4	4	4	mA
Peak RF Grid Voltage (approx.)	65	70	75	volts
RF Driver Power (approx.)	4.25	4.7	5.5	watts
Plate Power Input	185	240	500	watts
Useful Power Output	75	110	250	watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 VOLTS
PULSED SCREEN VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	-500 VOLTS
MAXIMUM PULSE DURATION	5 μS
PULSED CATHODE CURRENT	7 AMPS
AVERAGE POWER INPUT	250 WATTS
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200 MHz

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Current	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	-200	-250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 μsec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	350	350	350	volts
DC Grid Voltage*	-55	-55	-55	volts
Zero-Signal DC Plate Current	100	100	100	mA
Peak RF Grid Voltage**	50	50	50	volts
DC Plate Current	250	250	250	mA
DC Screen Current**	10	8	5	mA
Plate Input Power	250	375	500	watts
Plate Output Power	120	215	300	watts
Two-Tone Average DC Plate Current	190	190	190	mA
Two-Tone Average DC Screen Current**	2	-1	-2	mA

* Approximate values.

** Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direst tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this proceedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting The 4CX250K and 4CX250M may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures below 250° C. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals.

The table below lists the minimum cooling requirements at sea level with 50° C ambient air to maintain 225° C on the anode. For operation at 10,000 feet, the air-flow values should be multiplied by 1.46.

	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	Air Flow (CFM)	Static Pressure (inches of water)	Air Flow (CFM)	Static Pressure (inches of water)
150	3.5	0.3	3.1	0.2
200	4.3	0.4	4.6	0.4
250	5.5	0.7	6.1	0.7

ELECTRICAL

Heater The rated heater voltages for the 4CX-250K and 4CX250M are 6.0 and 26.5 volts, respectively and should be maintained at these values plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 500 MHz.

Frequency, MHz	4CX250K	4CX250M
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz, drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250K or 4CX250M.

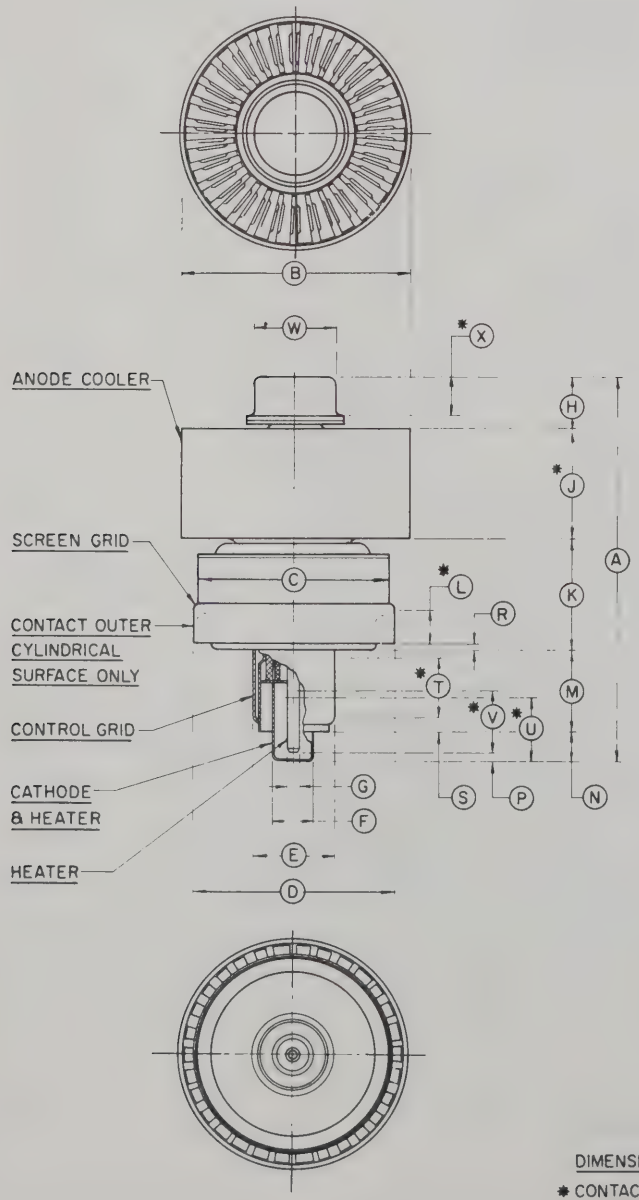
Plate Operation The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

UHF Operation The 4CX250K and 4CX250M are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

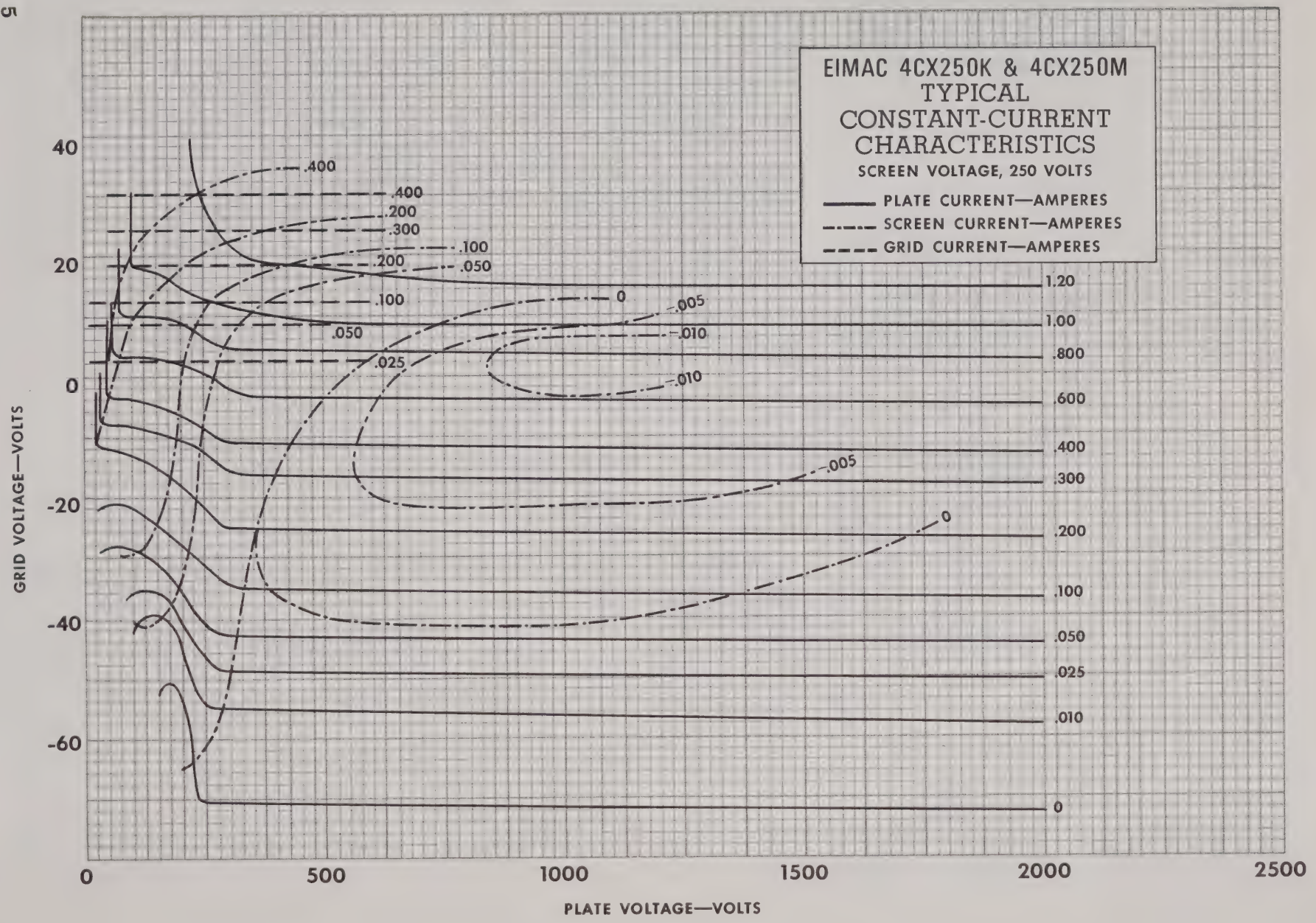
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

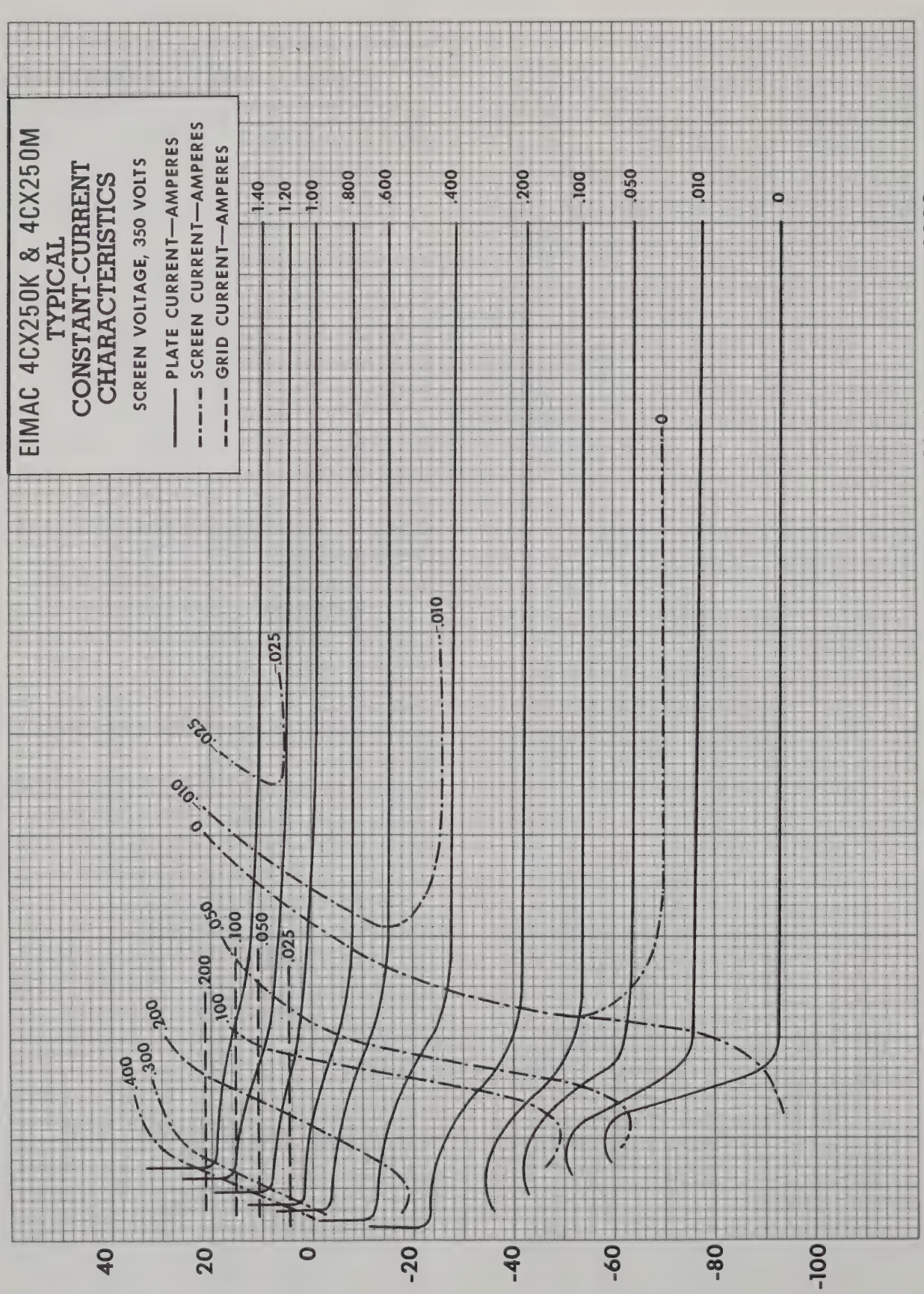
Special Applications If it is desired to operate these tubes under conditions widely different from those given here, write to Product Manager, Eimac Division of Varian, San Carlos, California, for information and recommendations.



DIMENSIONS		
REF.	MIN.	MAX.
A		2.813
B	1.610 DIA.	1.640 DIA.
C		1.406 DIA.
D	1.410 DIA.	1.440 DIA.
E	.587 DIA.	.597 DIA.
F	.317 DIA.	.327 DIA.
G	.088 DIA.	.098 DIA.
H		.358
J	.710	.790
K	.740	.820
L	.187	
M	.500	.580
N	.235	.265
P	.032	.062
R	.020 NOM.	
S	.125 NOM.	
T	11/32	
U	13/32	
V	15/32	
W	.559	.573
X	.240	.280

DIMENSIONS IN INCHES
* CONTACT SURFACE


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.010
.400
.400
.200
.300
.100
.200
.050
.100
.050
.025
0
.005
0


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.025
.010
0
.025
.010
0
.050
.025
.100
.050
.200
.100
.200
.300
.400
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
PLATE VOLTAGE—VOLTS
GRID VOLTAGE—VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8170
4CX5000A

RADIAL-BEAM POWER TETRODE

The EIMAC 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megahertz and is particularly suited for use as a linear single-sideband amplified, Class-AB_1 audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for Class-AB operation.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid Screen)		4.5		
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	pF
Output	18		23	pF
Feedback			1.0	pF

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	48	58	pF
Output	18	23	pF
Feedback		0.16	pF

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250°C
Maximum Anode-Core Temperature	250°C
Recommended Socket	EIMAC SK-300A
Recommended Chimney	EIMAC SK-306
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.13 inches
Diameter	4.94 inches
Cooling	Forced air
Net Weight	9.5 pounds
Shipping Weight (Approximate)	22 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megahertz)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	3 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION
(Frequencies below 30 megahertz)

DC Plate Voltage	7500 volts
DC Screen Voltage	500 volts
DC Grid Voltage	—350 volts
DC Plate Current	2.8 amps
DC Screen Current	0.5 amp
DC Grid Current	0.25 amp
Peak RF Grid Voltage	590 volts
Driving Power	150 watts
Plate Dissipation	5000 watts
Plate Output Power	16,000 watts

(Revised 4-15-69) © 1967, 1969 by Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR
(From 30 to 220 MHz)

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

DC PLATE VOLTAGE:	
30 to 60 MHz	7000 VOLTS
60 to 110 MHz	6500 VOLTS
110 to 220 MHz	5800 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT:	
30 to 60 MHz	2.8 AMPS
60 to 220 MHz	2.6 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION

	108MHz	220MHz	
DC PLATE VOLTAGE	6500	5500	volts
DC SCREEN VOLTAGE	750	680	volts
DC GRID VOLTAGE	-350	-140	volts
DC PLATE CURRENT	2.3	1.6	amperes
DC SCREEN CURRENT	.2	.034	amperes
DC GRID CURRENT	.05	.030	amperes
DRIVING POWER	100	---	watts
USEFUL OUTPUT POWER	10,000	5,500	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION*	3500 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megahertz)

DC Plate Voltage	5000 volts
DC Screen Voltage	500 volts
Peak AF Screen Voltage (For 100-percent modulation)	450 volts
DC Grid Voltage	—400 volts
DC Plate Current	1.4 amperes
DC Screen Current	0.26 ampere
DC Grid Current	0.05 ampere
Peak RF Grid Voltage	520 volts
Grid Driving Power	25 watts
Plate Dissipation	1100 watts
Plate Output Power	5.8 kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	3.0 AMPS
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Frequencies below 30 megahertz per tube)

DC Plate Voltage	7500	7500 volts
DC Screen Voltage	350	350 volts
Peak AF Screen Voltage (For 100-percent modulation)	550	550 volts
DC Grid Voltage	—300	—300 volts
DC Plate Current	0.9	1.14 amperes
DC Screen Current*	—0.01	—0.01 ampere
DC Grid Current	0.015	0.03 ampere
Peak RF Grid Voltage	350	375 volts
Grid Driving Power	7	11 watts
RF Load Impedance	2000	1600 ohms
Plate Dissipation	4000	5000 watts
Useful Output Power	2750	3550 watts

*DC Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, two tubes

DC Plate Voltage	4000	5000	6000	7000 volts
DC Screen Voltage	1250	1250	1250	1250 volts
DC Grid Voltage	—270	—280	—310	—325 volts
Max-Signal Plate Current	5.10	4.40	4.25	3.65 amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70 amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24 ampere
Zero-Signal Screen Current	0	0	0	0 amperes
Peak AF Driving Voltage	250	240	270	235 volts
Driving Power	0	0	0	0 watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100 ohms
Max-Signal Plate Dissipation*	4200	4200	4200	4200 watts
Max-Signal Plate Output Power	11,500	13,500	17,000	17,500 watts

*Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPS
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, Peak-Envelope or modulation-Crest Conditions, (Frequencies below 30 megahertz)

DC Plate Voltage	7500 volts
DC Screen Voltage	1250 volts
DC Grid Voltage*	—300 volts
Max-Signal Plate Current	1.9 amperes
Zero-Signal Plate Current	0.50 ampere
Max-Signal Screen Current	0.20 ampere
Peak RF Grid Voltage	300 volts
Driving Power	0 watts
Plate Dissipation	4200 watts
Plate Output Power **	10,000 watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or rf output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting — The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

Cooling — The maximum temperature rating for the external surfaces of the 4CX5000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megahertz).

Plate Dissipation* (Watts)	SK-300A Socket		SK-300 Socket	
	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

***Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.**

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation — The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation — The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

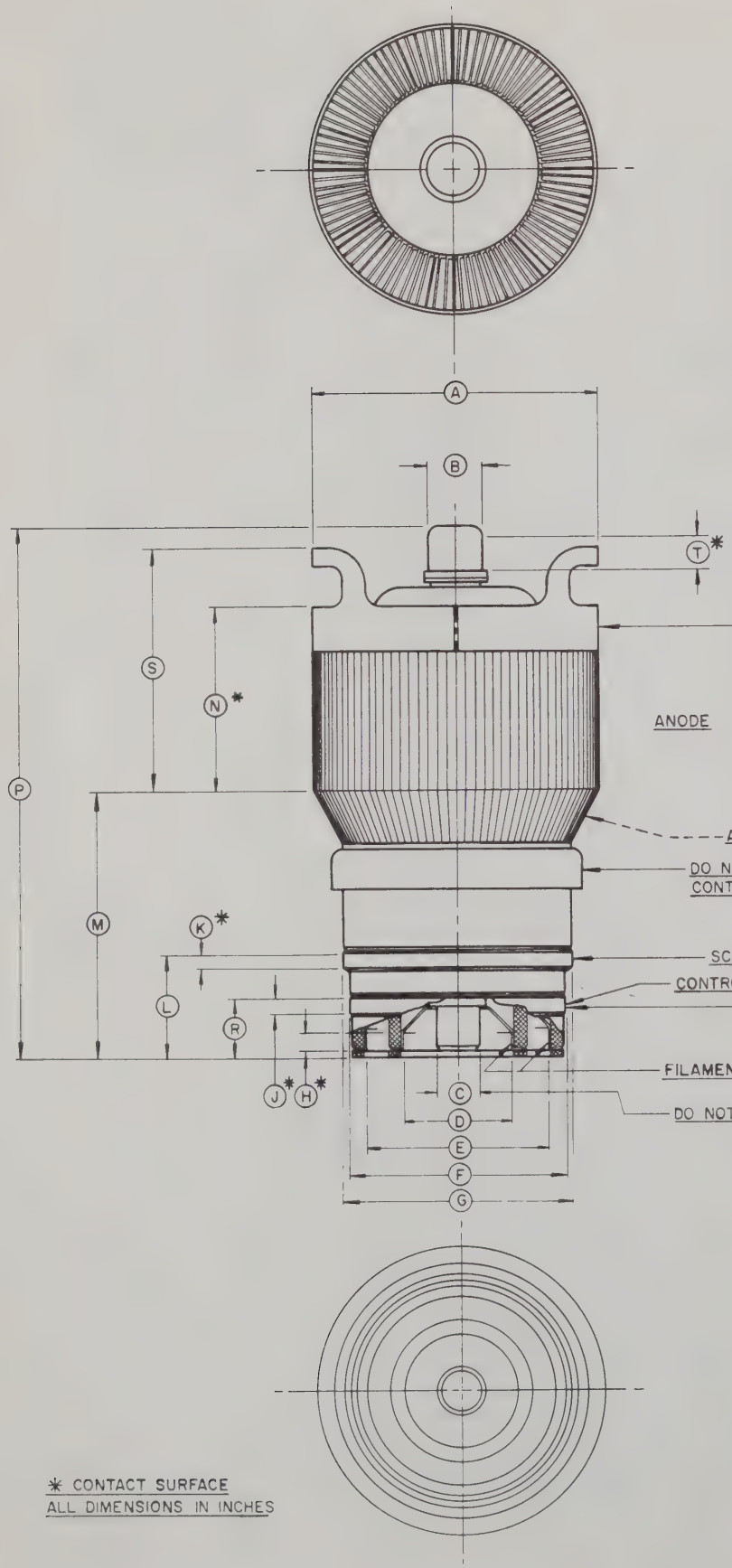
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

When the 4CX5000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

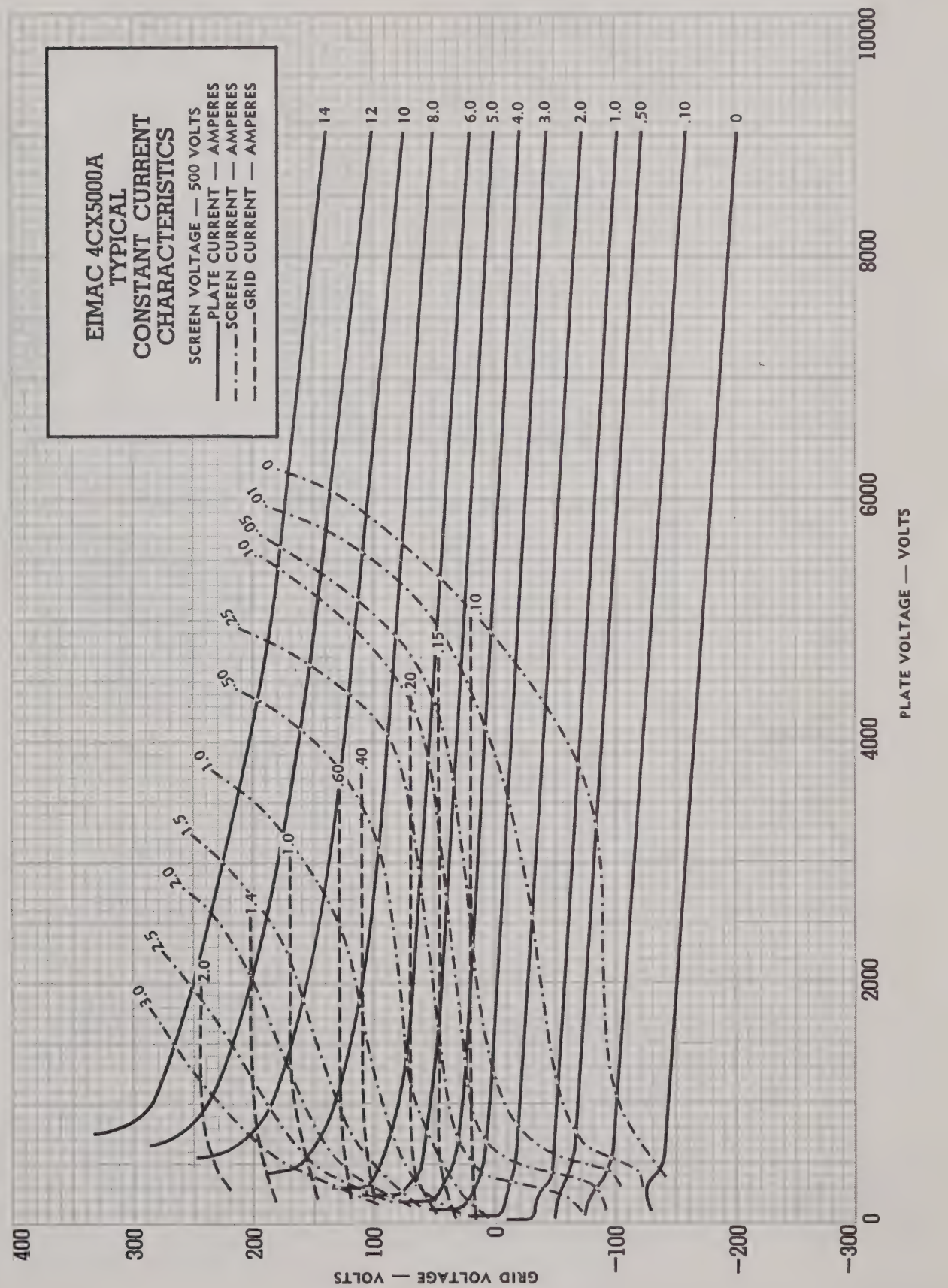
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

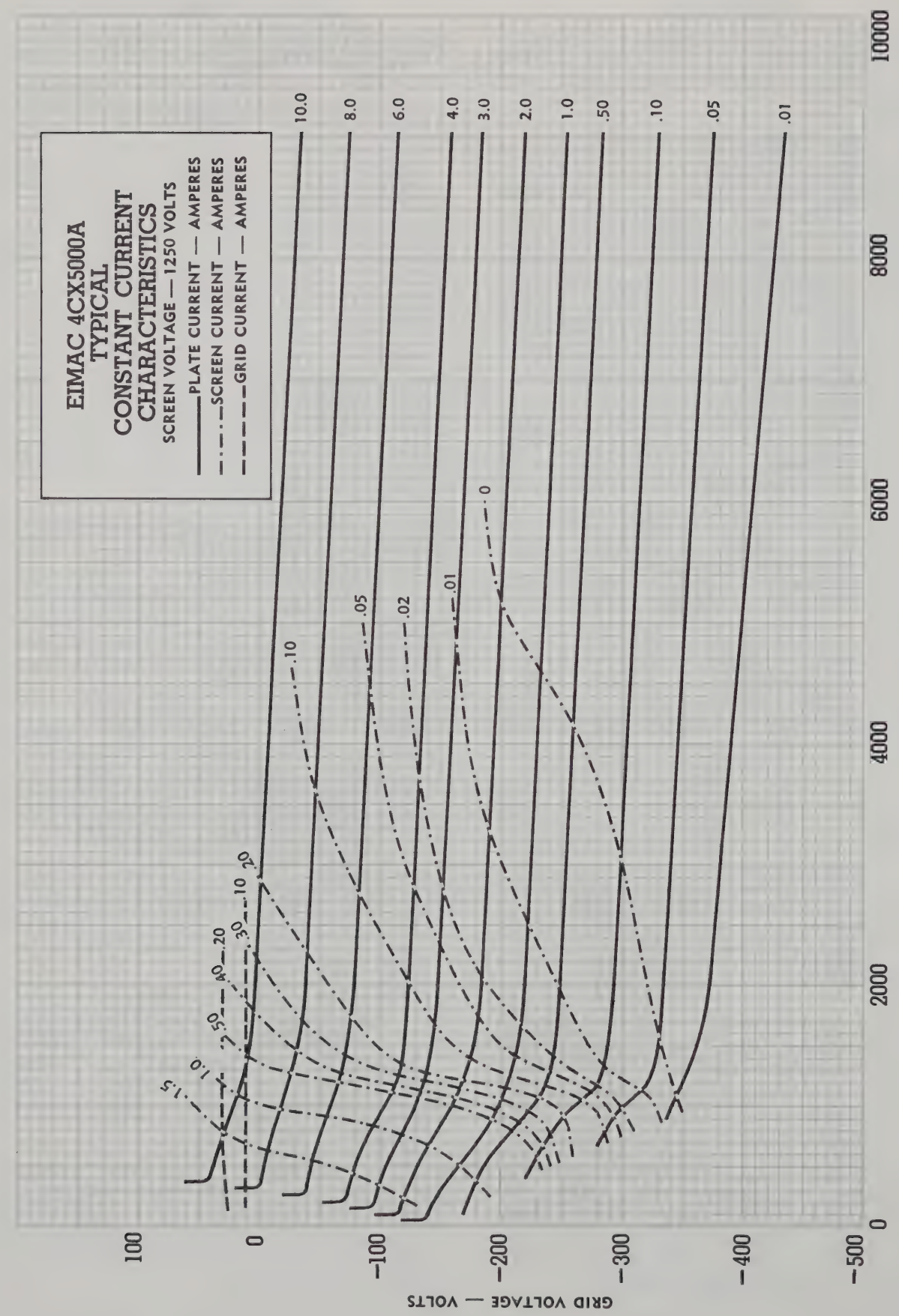
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4.812	4.938
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.188	4.563
N		2.875	3.250
P		8.625	9.125
R		.986	1.050
S		3.875	4.250
T		.375	



THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID AND ANODE CONTACT SURFACE WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT THE POINTS INDICATED BY THE ARROWS.

* CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.50
.10
.05
.01
0
.01
.02
.05
.10
1.0
1.5
2.0
2.5
3.0
4.0
5.0
10
20
30
40
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

5-500A

RADIAL-BEAM POWER PENTODE

•

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 5-500A is a compact, ruggedly constructed radial-beam power pentode having a maximum plate dissipation rating of 500 watts. It is intended for use as an amplifier, oscillator or modulator. The high plate current rating, low grid-plate capacitance and low driving power requirements permit maximum power capability to be combined with circuit simplicity and economic driver requirements.



The Eimac 5-500A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope and over the plate seal. Cooling may be greatly simplified by the use of the Eimac SK-400 or SK-410 Air System Socket and the accompanying Eimac SK-426 glass chimney. These sockets are designed to maintain the correct balance of cooling air between the component parts of the tube.

The suppressor element of the 5-500A terminates at the tube base shell, and is designed to be operated at ground (zero) potential. The base shell must be grounded by means of suitable spring clips.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten, balanced			
Voltage		10.0	volts
Current		10.2	amperes
Grid-Screen Amplification Factor (Average)		5.5	
Direct Interelectrode Capacitances, Grounded Cathode	*Min.*	*Max.*	
Grid-Plate	—	.10	pf
Input	15.0	19.0	pf
Output	9.5	12.0	pf

MECHANICAL

Base	see drawing
Basing	see drawing
Mounting Position	Vertical, base up or down
Cooling	Radiation and forced air
Recommended Heat Dissipating Connector	Eimac HR-6
Recommended Socket	Eimac SK-400 or SK-410 Air System Socket
Recommended Chimney	Eimac SK-426
Maximum Overall Dimensions	
Length	7.00 inches
Diameter	3.56 inches
Net Weight	11 ounces
Shipping Weight	2.5 pounds

NOTE: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

(Effective 5-1-68) © 1965, 1968 by Varian

Printed in U.S.A.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 Max. Volts
D-C SCREEN VOLTAGE	600 Max. Volts
D-C SUPPRESSOR VOLTAGE	100 Max. Volts
D-C PLATE CURRENT	450 Max. ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts
GRID DISSIPATION	12 Max. Watts

TYPICAL OPERATION

D-C Plate Voltage	2500	3000	4000 Volts
D-C Screen Voltage	500	500	500 Volts
D-C Grid Voltage	—210	—220	—240 Volts
D-C Suppressor Voltage	0	0	0 Volts
D-C Plate Current	405	432	450 ma
D-C Screen Current	55	65	65 ma
D-C Grid Current	28	35	38 ma
Screen Dissipation	27.5	32.5	33 Watts
Grid Dissipation	2.8	3.8	5.0 Watts
Peak R-F Grid Input Voltage	310	330	365 Volts
MF Driving Power*	8.7	12	14 Watts
Plate Power Input	1015	1300	1800 Watts
Plate Dissipation	265	495	500 Watts
Plate Power Output	750	805	1300 Watts

*Driving Power increases as frequency is increased.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1, Grounded Cathode, one tube

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 Max. Volts
DC SCREEN VOLTAGE	1000 Max. Volts
DC SUPPRESSOR VOLTAGE	100 Max. Volts
DC PLATE CURRENT	450 Max. ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts

TYPICAL OPERATION (Frequencies below 30 Mc.)
Peak-Envelope or Modulation-Crest Conditions.
Adjusted for minimum distortion.

DC Plate Voltage	2000	3000	4000 Volts
DC Screen Voltage	750	750	750 Volts
DC Suppressor Voltage	0	0	0 Volts
DC Control Grid Voltage*	—100	—112	—121 Volts
Zero-Signal DC Plate Current	150	100	80 mA
Single-Tone DC Plate Current	338	320	322 mA
Two-Tone DC Plate Current	252	221	212 mA
Single-Tone DC Screen Current	31	26	24 mA
Two-Tone DC Screen Current	15	12	10 mA
Peak RF Grid Voltage	100	112	121 Volts
Useful Output Power	395	612	832 Watts
Resonant Load Impedance	3600	5800	7700 Ohms
Third Order Intermodulation Products**	—52	—33	—28 db
Fifth Order Intermodulation Products**	—49	—41	—37 db

*1. Adjust to the specified zero-signal plate current.

**2. Equal or better than stated for all signal levels up to indicated useful output power. Reference to one tone of a two-tone test signal.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified.)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 Volts
DC SCREEN VOLTAGE	600 Volts
DC SUPPRESSOR VOLTAGE	100 Volts
DC GRID VOLTAGE	—500 Volts
DC PLATE CURRENT	340 ma
PLATE DISSIPATION	330 Watts
SCREEN DISSIPATION	35 Watts
GRID DISSIPATION	12 Watts

TYPICAL OPERATION

DC Plate Voltage	2700	3100	3500 Volts
DC Screen Voltage	450	470	500 Volts
DC Grid Voltage	—270	—310	—300 Volts
DC Suppressor Voltage	0	0	0 Volts
DC Plate Current	285	260	305 ma
DC Screen Current	68	50	55 ma
DC Grid Current	20	15	18 ma
Screen Dissipation	31	23	27 Watts
Peak A-F Screen Voltage Approx. (100% Modulation)	350	330	350 Volts
Peak R-F Grid Voltage	355	385	375 Volts
MF Grid Driving Power	7	6	7 Watts
Plate Dissipation	160	220	280 Watts
Plate Power Output	580	580	780 Watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	4000 Max. Volts
D-C SCREEN VOLTAGE	1000 Max. Volts
D-C SUPPRESSOR VOLTAGE	100 Max. Volts
MAX-SIGNAL D-C PLATE CURRENT	450 ma
PLATE DISSIPATION	500 Max. Watts
SCREEN DISSIPATION	35 Max. Watts
GRID DISSIPATION	12 Max. Watts

TYPICAL OPERATION CLASS AB_1
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	3000	4000 Volts
D-C Screen Voltage	750	750 Volts
D-C Suppressor Voltage	0	0 Volts
D-C Grid Voltage (approx.)*	—112	—121 Volts
Zero-Signal D-C Plate Current	200	160 ma
Max-Signal D-C Plate Current	640	645 ma
Zero-Signal D-C Screen Current	0	0 ma
Max-Signal D-C Screen Current	52	48 ma
Effective Load, Plate-to-plate	11,600	15,400 Ohms
Peak A-F Grid Input Voltage (per tube)	112	121 Volts
Driving Power	0	0 Watts
Max-Signal Plate Power Output	1224	1664 Watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

If it is desired to operate this tube under conditions widely different from those given under "Typical Operation," possibly exceeding the maximum ratings given for CW service, write Eimac, A Division of Varian Associates, for information and recommendations.

APPLICATION

MECHANICAL

MOUNTING—The 5-500A must be mounted vertically, base up or base down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the Eimac SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the Eimac HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING—Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the Eimac SK-400 or SK-410 Air-System Sockets and SK-426 chimney are used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System socket is not used, provision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive laquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

ELECTRICAL

FILAMENT VOLTAGE—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 10.0 volts. Variations in filament voltage must be kept within the range of 9.5 to 10.5 volts.

The 5-500A features a balanced filament structure to help the designer meet FCC hum and noise specifications in AM service.

BIAS VOLTAGE — The d-c bias voltage for the 5-500A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE—The d-c screen voltage for the 5-500A should not exceed 800 volts in r-f applications. In audio applications a maximum d-c screen voltage of 1,000 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

PLATE VOLTAGE—The plate-supply voltage for the 5-500A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the d-c plate-supply voltage should not exceed 3200 volts, except below 30 Mc., intermittent service, where 4000 volts may be used.

GRID DISSIPATION — Grid dissipation for the 5-500A should not be allowed to exceed 12 watts. Grid dissipation may be calculated from the following expression,

$$Pg = \varepsilon cmp Ic$$

where Pg = Grid Dissipation
εcmp = Peak positive grid to cathode voltage, and
Ic = D-C grid current

εcmp may be measured by means of a suitable peak voltmeter connected between filament and grid.

SCREEN DISSIPATION — The power dissipated by the screen of the 5-500A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION—Under normal operating conditions, the plate dissipation of the 5-500A should not be allowed to exceed 500 watts.

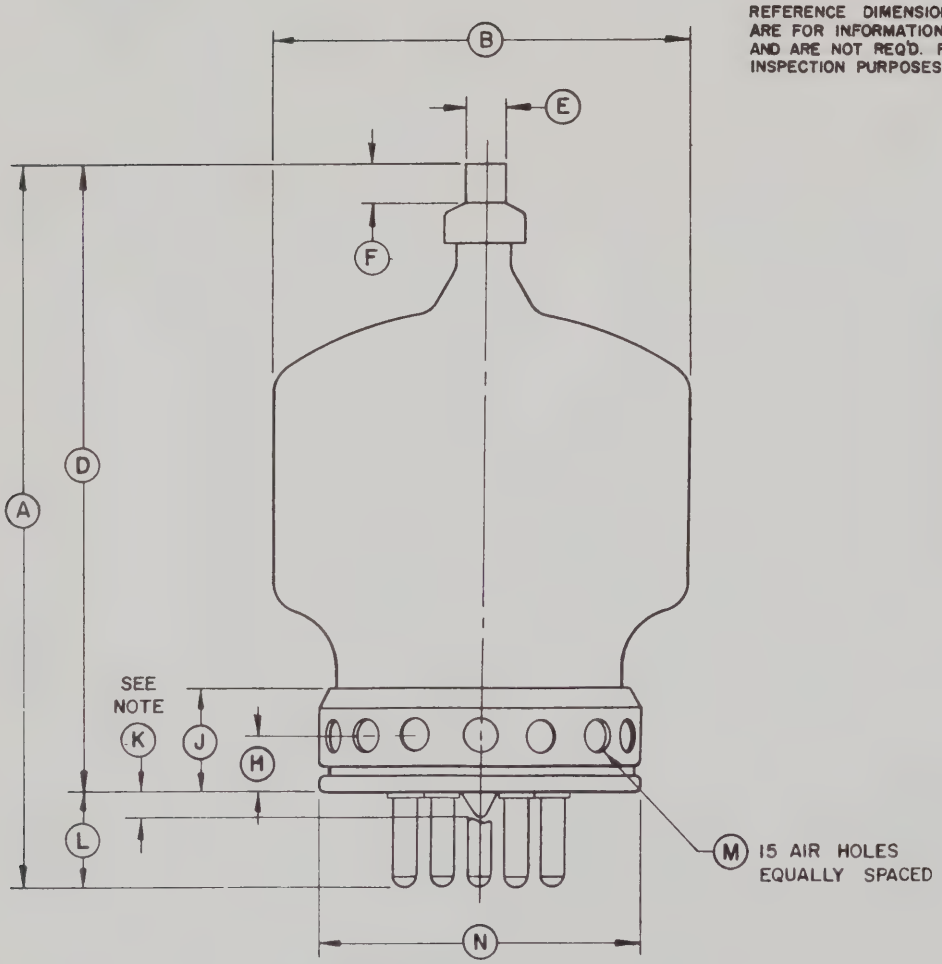
In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 330 watts. The plate dissipation may rise to 500 watts under 100% sinusoidal modulation.

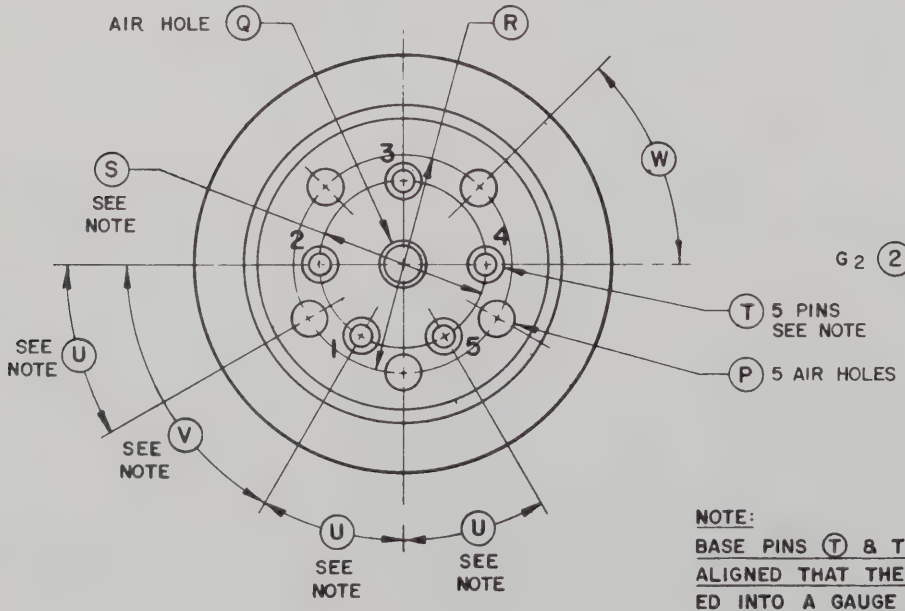
Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

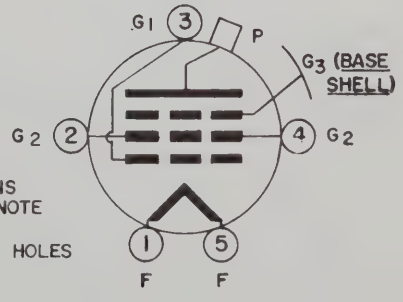
General information pertaining to the operation of the 5-500A may be found in Application Bulletin No. 8, "The Care and Feeding of Power Tetrodes." This Bulletin is available upon request.

REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQ'D. FOR INSPECTION PURPOSES.

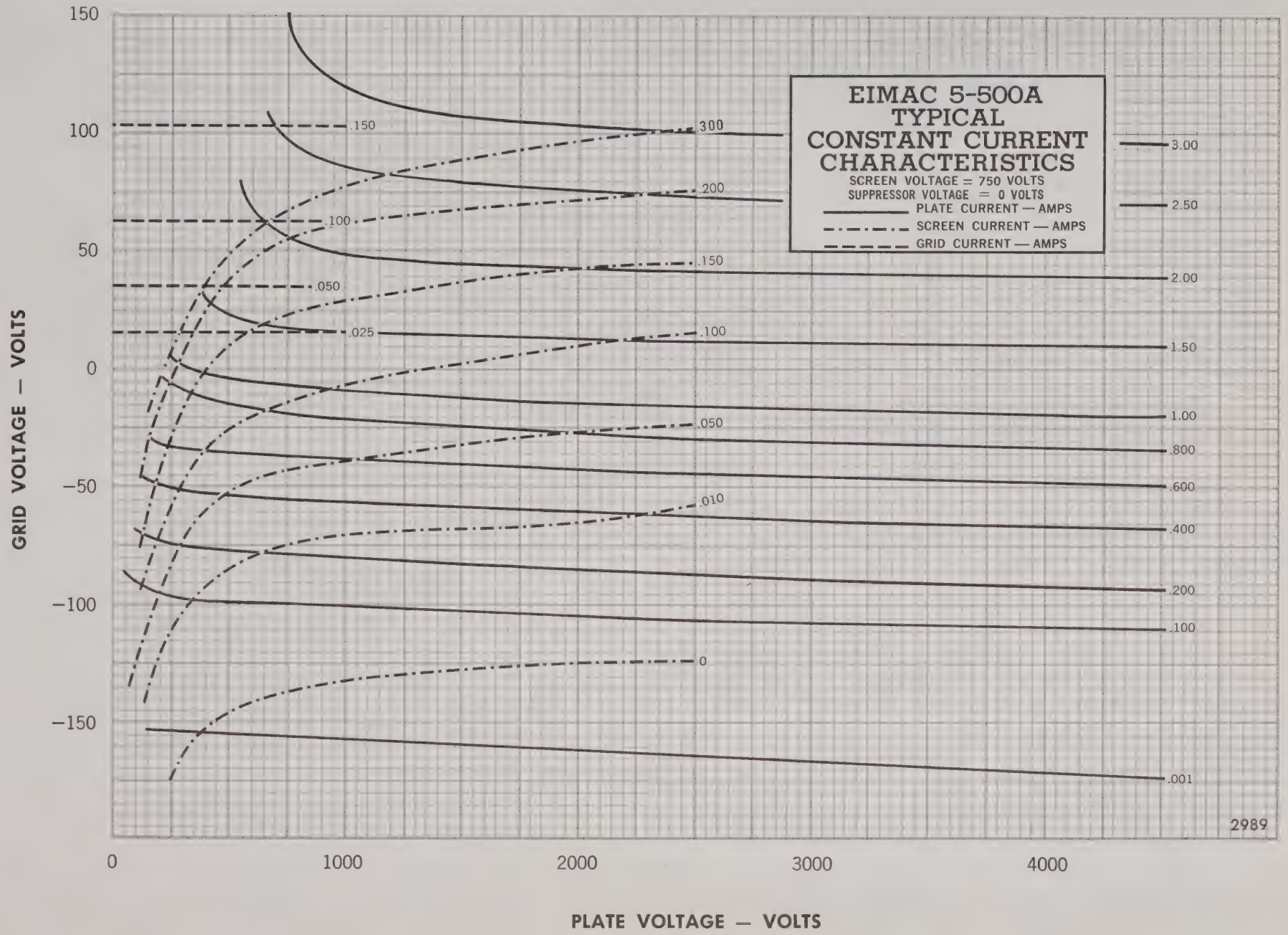
DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN	MAX.	REF.
A	6.500	7.000	
B		3-9/16 D.	
D	5.750	6.250	
E	.350 D.	.365 D.	
F	21/64		
H			7/16
J			31/32
K		1.1/4	
L			3/4
M			1/4 D.
N		2-3/4 D.	
P			5/16 D.
Q			1/2 D.
R			1-5/8 D.
S			1-1/4 D.P.C.
T	.185 D.	.191 D.	
U			30°
V			60°
W			45°

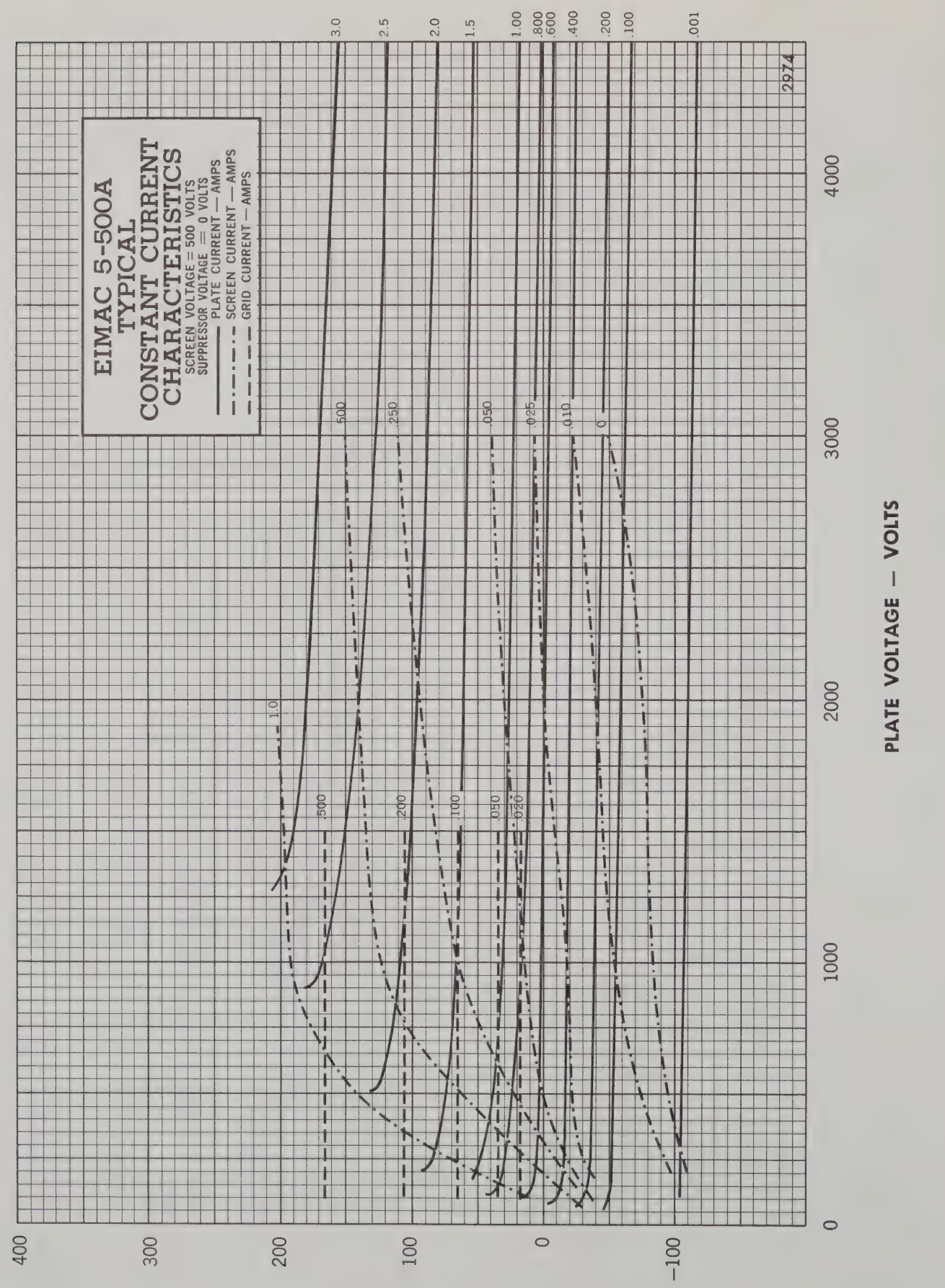






NOTE:
BASE PINS (T) & TUBULATION (K) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 RESPECTIVELY LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS (V), (U), (S).


EIMAC 5-500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
150
100
50
0
−50
−100
−150
0
1000
2000
3000
4000
.150
.100
.050
.025
.010
0
.001
300
200
150
100
050
025
010
3.00
2.50
2.00
1.50
1.00
.800
.600
.400
.200
.100
2989

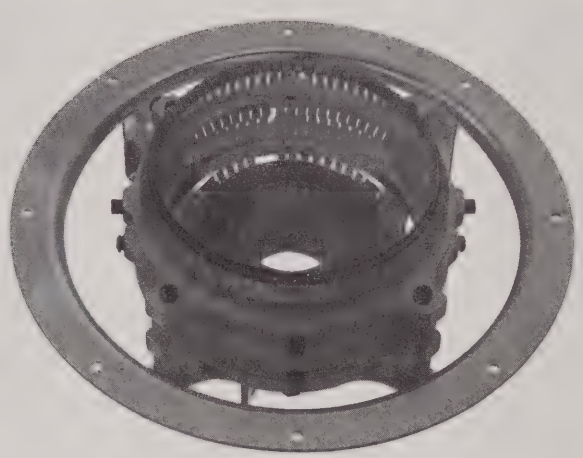

EIMAC 5-500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
3.0
2.5
2.0
1.5
1.00
.800
.600
.400
.200
.100
.001
500
250
050
025
010
0
1.0
500
200
100
050
025
010
2974
400
300
200
100
0
−100
0
1000
2000
3000
4000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-300A

AIR-SYSTEM SOCKET

The Eimac SK-300A Air-System Socket is recommended for use with those tube types listed at the bottom of the data sheet. The Eimac SK-306, SK-316 and SK-1306 Air Chimneys are available for use with this socket. When this socket is used, connection is made to each of the tube electrodes except the anode, by means of concentric rings of spring-finger contacts. The SK-300A is an improved version of the SK-300 with significantly reduced pressure drop at the air-flow rates used with these tubes. The cooling air horsepower requirements are appreciably lower for these tube types in an SK-300A as compared to the SK-300.



BASE CONNECTION

The SK-300A Air-System Socket consists of four concentric rings of spring-finger contacts. The socket is provided with two filament connectors with a ¼" diameter hole in each connector for making connection to the inner and outer filament contacts, one 6-32 terminal is provided for DC connection to the screen-grid. RF connection to the screen-grid may be made directly to the collet. The SK-300A has four 8-32 terminals for connection to the control-grid. The four contact rings are shown on the outline drawing.

MAXIMUM WORKING VOLTAGE:

Screen-Grid	3000 Vdc
Control-Grid	3000 Vdc

MATERIALS AND FINISHES

The socket body is made from brass silver-plated. The contact material is a non-ferrous spring alloy, Beryllium-copper, per QQ-C-533, heat treated for spring action and silver-plated, per QQ-S-365, for good RF conductivity. The insulation material is Teflon and Alsimag 665 ceramic.

INSTALLATION

The SK-300A Air-System Socket can be mounted on a chassis deck, partition or pressurized compartment. Chassis mounting is accomplished by cutting a 7-3/16" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by eight 6-32 machine screws through the eight holes provided for fastening. The SK-300A Air-System Socket is recommended for use with the following tubes:

8170/4CX5000A	8171/4CX10,000D
8170W/4CX5000R	8281/4CX15,000A
4CW10,000A	

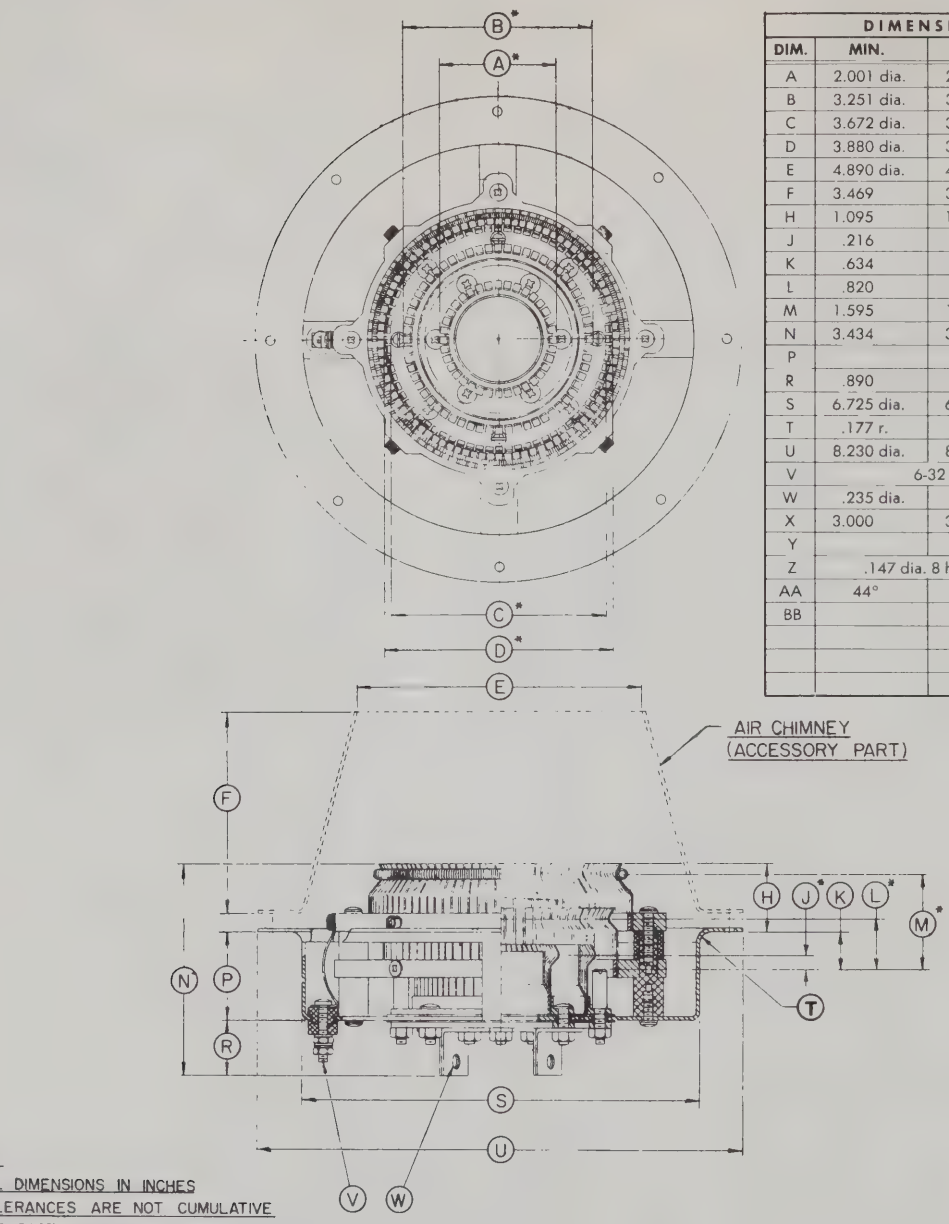
NET WEIGHT

SK-300A	3.25 lbs

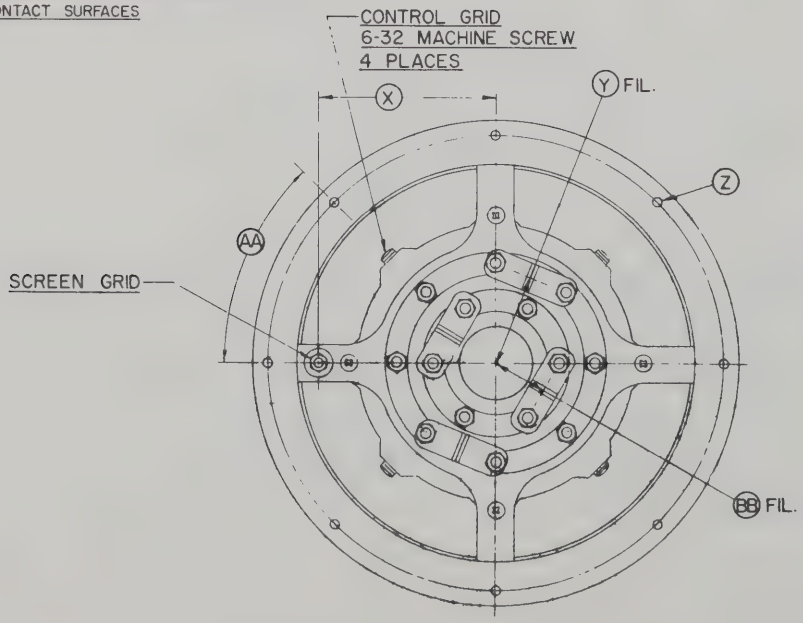
(Revised 4-15-69) © 1964, 1969 by Varian

Printed in U.S.A.

DIMENSION DATA			
DIM.	MIN.	MAX.	REF
A	2.001 dia.	2.061 dia.	
B	3.251 dia.	3.311 dia.	
C	3.672 dia.	3.732 dia.	
D	3.880 dia.	3.940 dia.	
E	4.890 dia.	4.921 dia.	
F	3.469	3.531	
H	1.095	1.140	
J	.216	.240	
K	.634	.689	
L	.820	.856	
M	1.595	1.657	
N	3.434	3.581	
P			1.500
R	.890	.940	
S	6.725 dia.	6.766 dia.	
T	.177 r.	.187 r.	
U	8.230 dia.	8.266 dia.	
V	6-32 NC-2A STUD		
W	.235 dia.	.265 dia.	
X	3.000	3.030	
Y			1.575
Z	.147 dia. 8 holes on 7¾ dia. p.c.		
AA	44°	46°	
BB			.950



NOTES
1. ALL DIMENSIONS IN INCHES
2. TOLERANCES ARE NOT CUMULATIVE
3. * CONTACT SURFACES



EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

SK-506
SK-516

AIR-SYSTEM CHIMNEY



The SK-506 and SK-516 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat radiating connector.

MATERIALS

The SK-506 and SK-516 Air-System Chimneys are made of heat resistant Pyrex glass. The bottom edge is ground flat for a tight air seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

These chimneys are designed for above-chassis installation over the companion Air-System Socket. Four Spring Clips supplied with the SK-500 and SK-510 sockets ground the metal tube base and act as retaining clips for the chimney.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-506	4-1000A 4PR1000A 4PR1000B	SK-500
SK-516	3-1000Z	SK-510

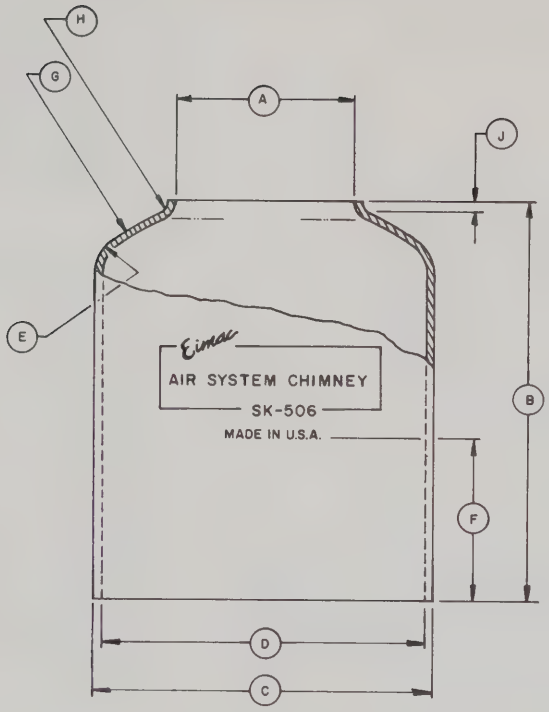
Net Weight

SK-506 . . . . . 10 ounces

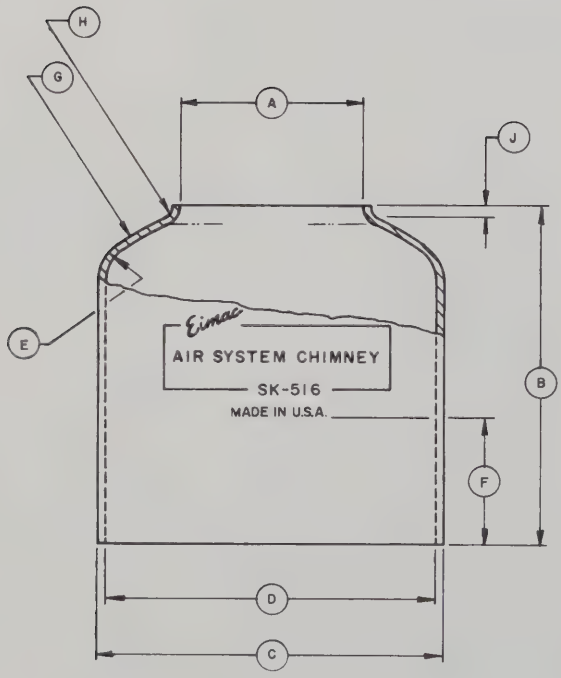
SK-516 . . . . . 8 ounces

(Revised 4-15-69) © 1963, 1964, 1969 by Varian

Printed in U.S.A.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	3.188	3.313	
B	7.187	7.375	
C		6.125	
D	5.625	5.875	
E			.750
F	2.937	3.062	
G			4.625
H			.188
J			.188



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	3.188	3.313	
B	6.437	6.625	
C		6.125	
D	5.625	5.875	
E			.750
F	2.187	2.312	
G			4.625
H			.188
J			.188

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

TABLE OF CONTENTS

VOLUME I

GENERAL

	Effective Date
Tube Type Numbering System	2-1-67
Distributors	7-1-67
EIMAC and EIA Power Grid Tube Number Cross Reference Sheet	1-1-67
Power Frequency Chart for Power Grid	

DIODES – RECTIFIERS – PULSE MODULATORS

2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	12-15-65
2-240A	10-21-59
2-450A	3-1-66
2-2000A	7-1-52
2X3000F	3-1-67
250R	12-15-65
253	7-1-52
575A & 673	4-1-67
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020(100R)	6-1-67
4PR60B/8252	11-1-66
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	6-1-66
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65
KY21A	7-1-66
RX21A	1-2-63

TRIODES

2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	3-15-67
3-1000Z/8164	3-15-67
3C24	11-1-51
3CPN10A5/7815	4-15-67
3CPX100A5/7815R	4-15-67
3CV30,000A3	3-1-67
3CW5000A3	6-1-67
3CW5000H3	4-1-66
3CW10,000H3	7-15-66
3CW20,000A1	1-1-63
3CW20,000A3	6-1-66
3CW20,000A7	1-1-63
3CW20,000H3	2-1-65
3CW25,000A3	3-1-67
3CW30,000H3	2-1-65
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-15-66
3CX2500A3/8161	3-1-67
3CX2500F3	3-1-67

TRIODES (Continued)

3CX2500H3	3-15-66
3CX3000A7	5-15-67
3CX5000H3	4-1-66
3CX10,000A1/8158	8-14-64
3CX10,000A3/8159	8-15-64
3CX10,000A7/8160	6-1-67
3CX10,000H3	3-15-66
3CX15,000A3	4-11-64
3CX15,000H3	4-1-66
3W5000A1/8240	8-15-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
25T	12-15-65
35T	12-30-57
*35TG	6-1-67
75TH	12-15-65
75TL	4-1-67
100TH	4-1-67
100TL	———
*152TH	11-25-52
*152TL	4-1-67
250TH	6-15-66
250TL	1-1-61
304TH	4-1-67
304TL	6-1-67
450TH	12-15-65
450TL	12-15-65
592/3-200A3	6-15-66
750TL	12-15-65
1000T	12-15-65
1500T	3-18-59
2000T	10-15-50
5867A	11-15-64
6696A	10-15-64
6697A	10-15-64
7211	6-1-67
7480	10-15-64

TETRODES – PENTODES

4-65A/8165	5-1-62
4-125A	6-1-67
4-250A/5D22	5-1-62
4-400A	8-30-66
4-1000A/8166	10-30-66
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	5-15-66
4CV100,000C/8351	3-15-65
4CW2000A	6-15-66
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	6-1-67
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63

TETRODES–PENTODES (Continued)

4CX250R	6-16-61
4CX300A/8167	8-30-66
4CX300Y	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX1000A/8168	6-1-67
4CX1000K/8352	8-20-66
4CX1500B	6-1-67
4CX3000A/8169	5-1-67
4CX5000A/8170	5-1-67
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	8-15-66
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	8-30-66
4X150G/8172	6-15-66
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
4E27A/5-125B	8-15-52
5-500A	11-15-65
5CX1500A	4-15-67

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
Preformed Contact Finger Stock	8-15-66
HR Heat Dissipating Connectors	12-1-65
SK-300A	11-1-64
SK-306, SK-316	8-15-66
SK-400	4-1-56
SK-406, SK-416, SK-426	6-1-67
SK-410	11-15-62
SK-500	3-15-67
SK-506, SK-516	8-15-64
SK-510	8-15-66
SK-600A, SK-610A	11-1-65
SK-606, SK-626, SK-636B	8-15-66
SK-620, SK-620A	3-15-67
SK-630, SK-630A	3-15-67
SK-640	2-15-66
SK-650, SK-655	1-15-66
SK-700, SK-710	10-15-66
SK-711A	4-15-67
SK-740	8-15-66
SK-760, SK-770	8-15-66
SK-800B, SK-806	4-9-64
SK-810B, SK-806	4-9-64
SK-860, SK-870	3-15-67
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300	8-15-66
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66

*Not recommended for New Equipment Design.

Effective Date 7-15-67

TECHNICAL DATA

8283
3CX1000A7

HIGH-MU
POWER TRIODE

The EIMAC 8283/3CX1000A7 is a ceramic-metal zero-bias triode intended for Class-AB2 linear amplifier service in either grid-driven or cathode-driven configuration. It is recommended for use as a grid driven, push-pull audio amplifier or modulator and as a cathode driven linear amplifier through the VHF-TV bands.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-Tungsten Mesh	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	30.5 A
Amplification Factor (Average)	200
Direct Interelectrode Capacitance (Grounded Cathode)[2]	
Cin	32.0 pF
Cgp	14.0 pF
Cout	0.15 pF
Direct Interelectrode Capacitance (Grounded Grid)[2]	
Cin	32.0 pF
Cpk	0.15 pF
Cout	14.0 pF
Frequency of Maximum Ratings	220 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or produce refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.80 in; 121.9 mm
Diameter	3.38 in; 85.8 mm
Net Weight	2 lb; 0.91 kg
Operating Position	Vertical, base up or down
Cooling	Forced Air
Base	Special Breechlock
Recommended Air-System Socket	EIMAC SK-860 or SK-870
Recommended Air Chimney	EIMAC SK-816
Maximum Temperature, Anode Core & Ceramic/Metal Seals	250°C

(Effective 3-25-75) © 1963, 1968, 1975 by Varian

Printed in U.S.A.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_2 Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	45	WATTS

TYPICAL OPERATION, (Two tubes)

Plate Voltage	2000	2500	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current	400	500	mAdc
Max-Signal Plate Current	2.0	2.0	Adc
Max-Signal Grid Current	590	480	mAdc
Peak AF driving Voltage (per tube)	95	90	v
Driving Power	25	44	W
Load Resistance (plate-to-plate)	1900	2580	Ω
Max-Signal Plate Output Power	2350	3100	W

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_2, Grounded-Grid

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	45	WATTS

TYPICAL OPERATION

Plate Voltage	2000	2500	3500	Vdc
Grid Voltage [1]	0	0	-12	Vdc
Zero-Signal Plate Current	238	305	129	mAdc
Single-Tone Plate Current	875	800	857	mAdc
Two-Tone Plate Current	600	585	590	mAdc
Single-Tone Grid Current	230	205	225	mAdc
Two-Tone Grid Current	130	120	120	mAdc
Peak RF Driving Voltage	80	74	110	v
Driving Power	80	60	100	W
Peak Envelope Power Output	940	1170	2060	W
Resonant Load Impedance	1100	1670	2300	Ω
RF Driving Impedance	40	45	60	Ω
Third Order IM Distortion [2]	-29	-31	-31	dB
Fifth Order IM Distortion [2]	-37	-40	-39	dB

1. The bias voltage in this set of typical operating conditions was obtained by means of a -12 volt 50 watt Zener diode in the negative return to the center-tap of the filament transformer.

2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.

RADIO-FREQUENCY AMPLIFIER OR OSCILLATOR - Class C.

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.7	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	45	WATTS

PLATE MODULATED RADIO-FREQUENCY AMPLIFIER - Class C.

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.55	AMPERE
PLATE DISSIPATION	670	WATTS
GRID DISSIPATION	45	WATTS

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current, at 5.0 volts	28.0	33.0	A
Zero Bias Plate Current, with E_b = 2500 Vdc	250	350	mA
Cut-off Grid Voltage (E_b = 2500 Vdc; I_b = 1.0 mA)	---	-25	V
Interelectrode Capacitances (Grounded Cathode) [1]			
Cin	29.0	35.0	pF
Cout	---	0.2	pF
Cgp	12.0	16.0	pF
Interelectrode Capacitances (Grounded Grid) [1]			
Cin	29.0	35.0	pF
Cout	12.0	16.0	pF
Cpk	---	0.2	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - The 3CX1000A7 must be operated with its axis vertical, base up or down. The EIMAC SK-860 and SK-870 air-system sockets are available for use with the tube. The SK-870 has its grid contacts grounded to the socket frame. No contacts are grounded with the SK-860. The EIMAC SK-816 air-chimney is also available to direct cooling air from the socket through the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces and the anode core of the 3CX1000A7 is 250°C. Tube life is prolonged if these areas are maintained at somewhat lower temperatures. The table lists air-flow requirements to maintain tube temperatures below 225°C with 50°C inlet air and base-to-anode air flow.

Plate Diss. (watts)	Air Flow (cfm)	Press. Drop (In. H_2O)
SEA LEVEL		
600	12	0.12
800	16	0.19
1000	20.5	0.30
1500	33	0.65
10,000 FEET		
600	18	0.18
800	24	0.28
1000	31	0.45
1500	50	0.97

FILAMENT - Rated filament voltage for the 3CX1000A7 is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 3CX1000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of five or more.

CLASS-C OPERATION - Although designed for Class-AB_2 service, the 3CX1000A7 may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias, provided the anode voltage is not over 2500 Vdc. If driving power fails under these circumstances, plate dissipation will be kept within the maximum rating since the tube will operate at normal static zero-bias conditions.

For Class C operation with anode voltage in excess of 2500 Vdc additional protective bias voltage is required.

INTERLOCKS - An interlock device should be provided to insure that cooling air is established before application of electrical power, including the filament voltage. The circuit should be so arranged that rf drive cannot be applied in the absence of normal anode voltage.

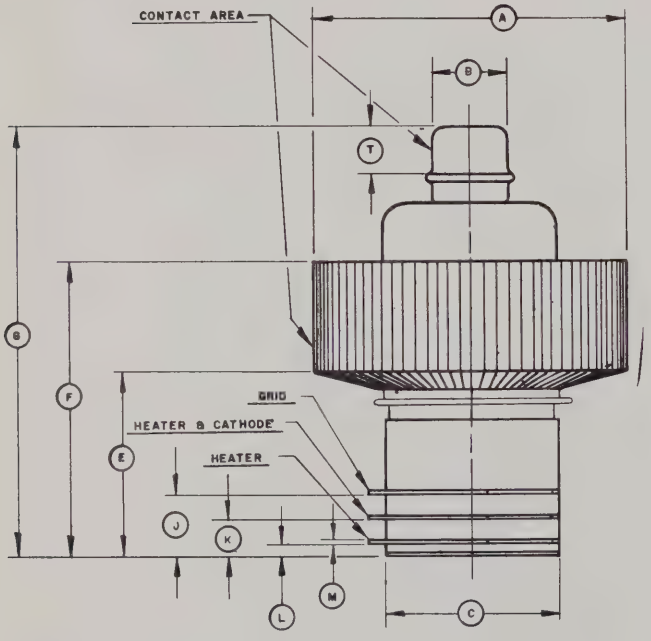
HIGH VOLTAGE - The 3CX1000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between the tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and Military Services use a standard test procedure as described in Electronic Indus-

tries Association Standard RS-191. This requires the use of specially constructed test fixtures with effectively shield all external tube terminals or leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

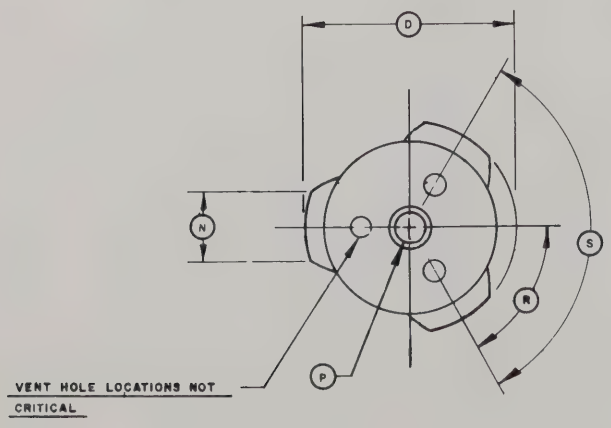
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

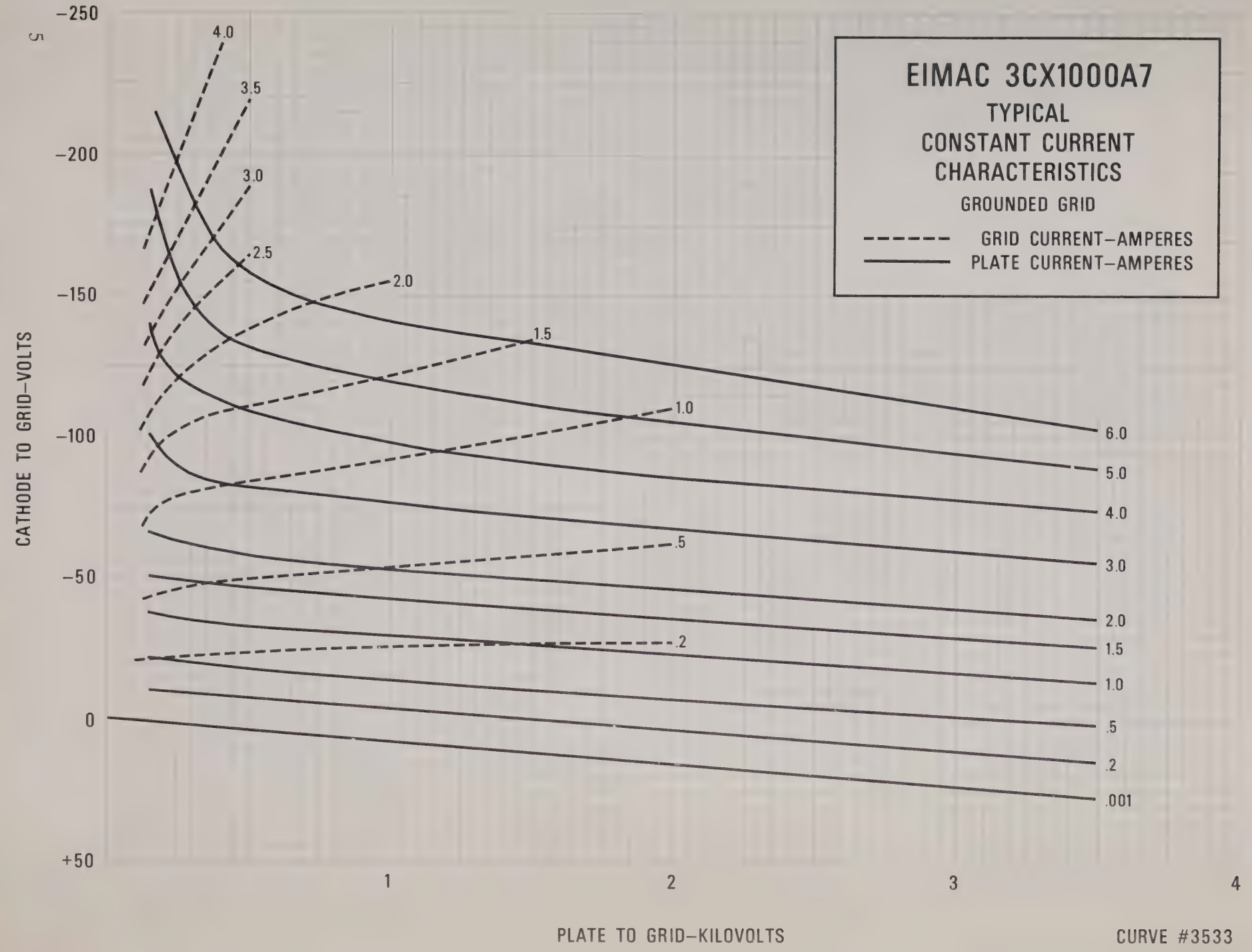
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.325	3.375	- -	84.45	85.72	- -
B	0.807	0.817	- -	20.50	20.75	- -
C	1.870	1.900	- -	47.50	48.26	- -
D	2.250	2.300	- -	57.15	58.42	- -
E	2.000	2.194	- -	50.80	55.73	- -
F	3.175	3.375	- -	80.64	85.72	- -
G	4600	4.800	- -	116.8	121.9	- -
J	0.690	0.710	- -	17.53	18.03	- -
K	0.415	0.435	- -	10.54	11.04	- -
L	0.140	0.165	- -	3.56	4.19	- -
M	0.020	0.030	- -	0.508	0.762	- -
N	0.700	0.800	- -	17.78	20.32	- -
P	0.314	0.316	- -	7.97	8.03	- -
R	55°	65°	- -	55°	65°	- -
S	115°	125°	- -	115°	125°	- -
T	0.470	0.530	- -	11.94	13.46	- -

NOTE:
REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.




EIMAC 3CX1000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
GRID CURRENT–AMPERES
PLATE CURRENT–AMPERES
CATHODE TO GRID–VOLTS
−250
−200
−150
−100
−50
0
+50
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
.2
6.0
5.0
4.0
3.0
2.0
1.5
1.0
.5
.2
.001
1
2
3
4
PLATE TO GRID–KILOVOLTS
CURVE #3533

3CW25,000A3

MEDIUM-MU

WATER-COOLED
POWER TRIODE

EITEL-McCULLOUGH, INC.

The Eimac 3CW25,000A3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is rated at 25 kilowatts of plate dissipation with low water flow and pressure drop.

Full input of 60 kilowatts is permissable up to 100 megacycles. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe applications.

It is also recommended as a grounded grid FM amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL	Min.	Nom.	Max	
Filament: Thoriated-Tungsten				
Voltage		6.3		volts
Current	152		172	amperes
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	$\mu\mu$f
Plate-Filament	1.2		1.5	$\mu\mu$f
Grid-Plate	30		38	$\mu\mu$f
Frequency for Maximum Ratings				100 Mc

MECHANICAL	
Base	Coaxial
Recommended Socket	Eimac SK-1300
Operating Position	Vertical, base up or down
Cooling	Water & Forced air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	9.4 inches
Diameter	5.0 inches
Net Weight	12 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION	25 KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000 volts
DC Plate Current	6.0	6.0 amps
DC Grid Voltage	–600	–800 volts
DC Grid Current	.66	.315 amps
Peak Positive Grid Voltage	440	360 volts
Driving Power	660	365 watts
Plate Input Power	42	60 kW
Plate Dissipation	12	18 kW
Plate Output Power	30	42 kW
Approximate Load Impedance	600	750 ohms

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

RADIO-FREQUENCY POWER AMPLIFIER
PLATE-MODULATED

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	16.5 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000 volts
DC Grid Voltage	–600	–820 volts
DC Plate Current	5.0	5.0 amps
DC Grid Current	600	600 mA
Driving Power	600	750 watts
Plate Output Power	17.8	27.5 kW

RADIO-FREQUENCY
LINEAR AMPLIFIER Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10000 MAX. VOLTS
DC PLATE CURRENT	6.0 MAX. AMPS
PLATE DISSIPATION	25 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Adjust to give specified zero-signal dc plate current

TYPICAL OPERATION

DC Plate Voltage	7000	10000 volts
DC Grid Voltage*	–250	–400 volts
Zero-Sig Plate Current	2.0	2.0 amps
Max-Sig DC Plate Current	6.0	6.0 amps
Max-Sig DC Grid Current	375	333 mA
Peak RF Grid Voltage	530	700 volts
Driving Power	200	240 watts
Plate Output Power	26.4	41 kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament—The rated filament voltage for the 3CW-25,000A3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation—The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

Plate Operation—The maximum plate input power rating is 60 kilowatts at 10,000 volts and 6.0 amperes dc. This rating applies for Class C amplifier or oscillator service and for Class AB applications. When used as a plate modulated rf amplifier, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation—The 3CW25,000A3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in class A, B or C service. For plate-modulated applications at 140 Mc, plate voltage is reduced to 5500 volts.

Mounting—The 3CW25,000A3 must be mounted vertically, either base up or down. Where the tube is installed in a base up position, it is suggested that any clamping pressure or rf contact be made only in the area shown as "V" on the outline drawing.

Socket—The Eimac SK-1300 socket is used with the 3CW25,000A3 for making connections to the filament and grid. Where the socket is to be removable–as in base-up operation–the SK-1310 should be used.

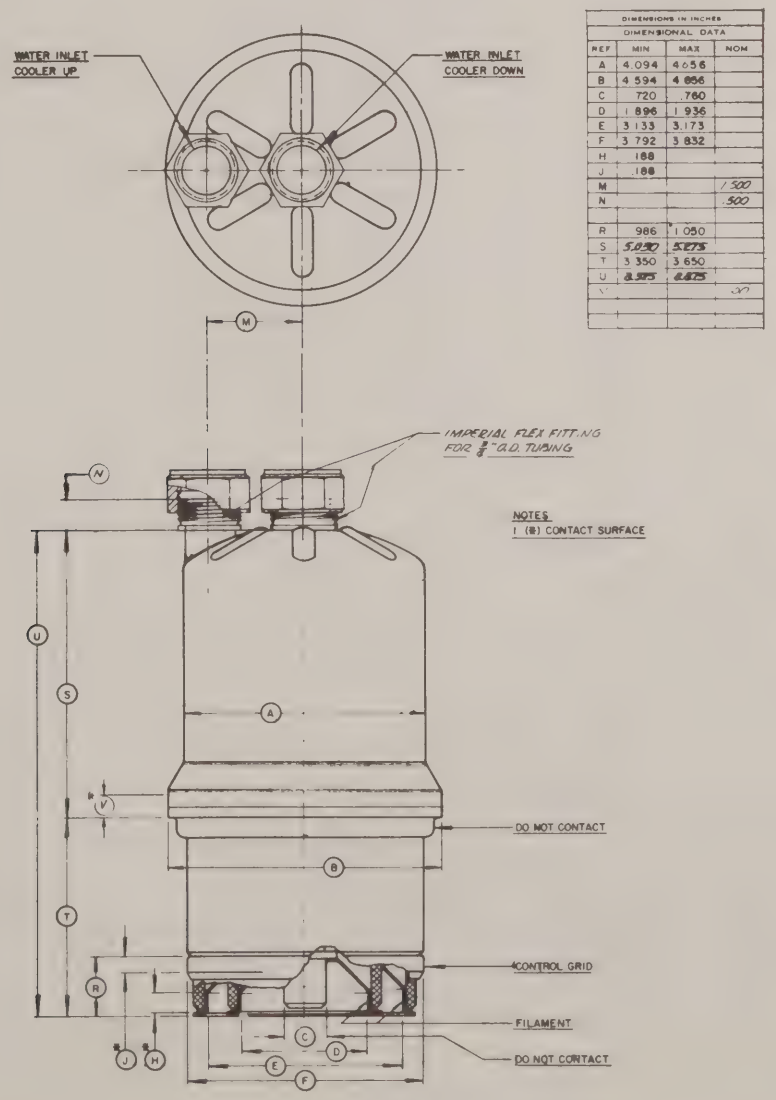
Cooling—Anode cooling is accomplished by circulating water through the integral anode–water jacket. With the tube in the anode-up position the water inlet is the outer water fitting and the outlet will be the center water fitting. When the tube is mounted base up, these are reversed.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, inlet water temperature must be limited to 60°C or below, outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi.

Minimum Water-Cooling Requirement		
Plate Dissipation (kW)	Water Flow (GPM)	Pressure Drop (PSI)
10	6	0.2
15	9	0.4
20	12	0.7
25	15	1.1

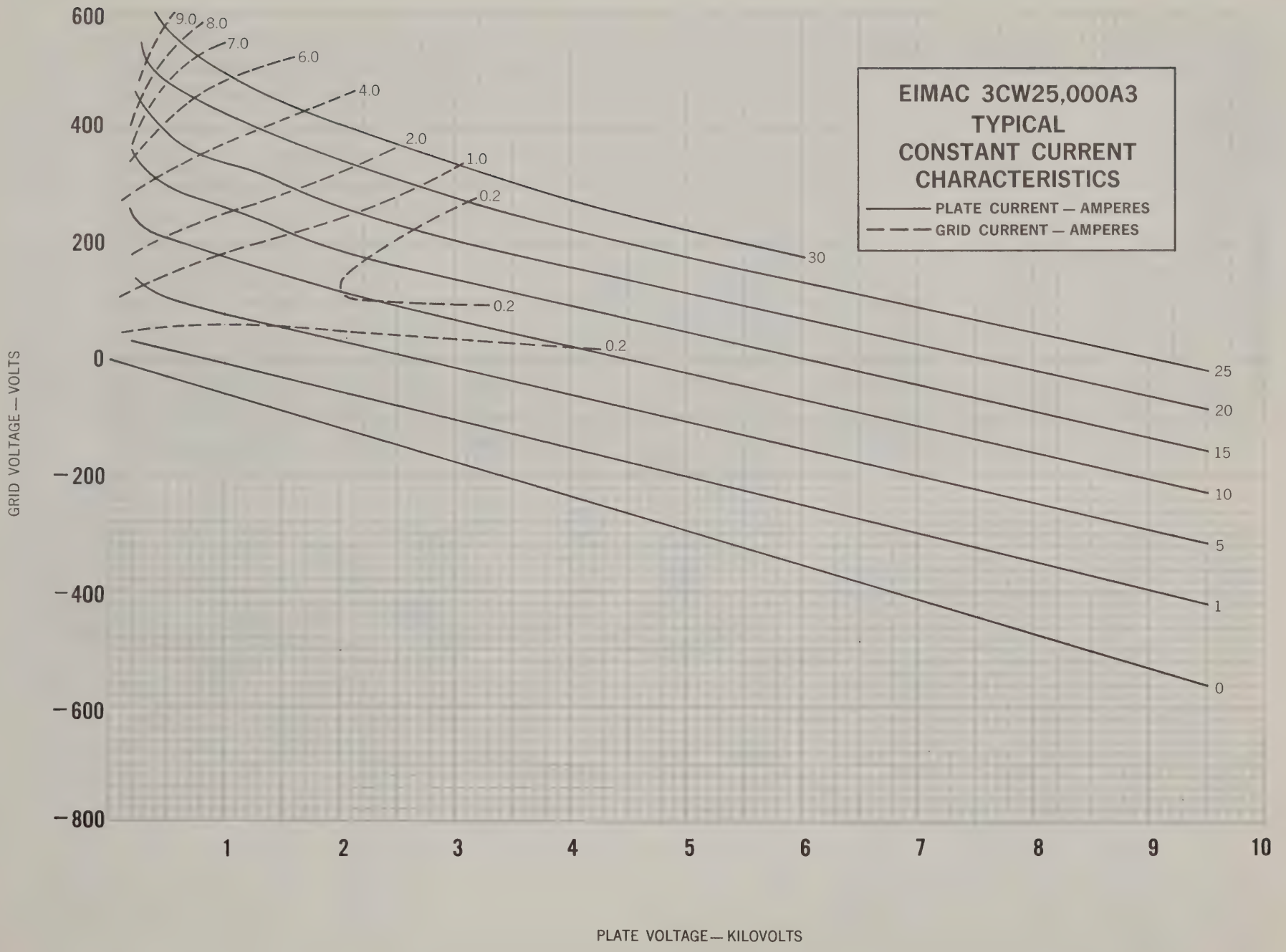
Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 50 cfm of cooling air directed into the base structure, through the socket will generally satisfy this requirement.

Special Application—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.



DIMENSIONS IN INCHES
DIMENSIONAL DATA

REF	MIN	MAX	NOM
A	4.094	4.656	
B	4.594	4.656	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
H	.188		
J	.188		
M			1.500
N			.500
R	.986	1.050	
S	5.090	5.875	
T	3.350	3.650	
U	8.395	8.675	


EIMAC 3CW25,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE — KILOVOLTS
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
30
25
20
15
10
5
1
0

4CX300Y

CERAMIC

POWER TETRODE

EITEL-McCULLOUGH, INC.

The Eimac 4CX300Y is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 400 watts. The 4CX300Y may be operated at maximum ratings to 110 Mc.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300Y especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential	-	-	±150	volts
Heater: Voltage (See "Application")	-	6.0		volts
Current (E_f=6.0 volts)	3.0		3.85	amperes
Amplification Factor (Grid to Screen)	4.0		5.6	
Transconductance (I_b=200 ma.)		12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	30		38	uuf
Output	3.9		5.0	uuf
Feedback	-	-	0.07	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input	-	18		uuf
Output	3.9		5.0	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	Special, breechblock terminal surfaces
Recommended Socket	Eimac SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	- 250° C
Anode Core	- 250° C
Cooling	Forced Air
Maximum Over-All Dimensions:	
Height	2.5 inches
Diameter	1.65 inches
Net Weight	4 ounces
Shipping Weight (Approximate)	1 pound

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	—250 MAX. VOLTS
DC PLATE CURRENT	400 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID DISSIPATION	1 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	—90	—90	—90 volts
DC Plate Current	0.38	0.4	0.4 amps
DC Screen Current*	31	26	26 mA
DC Grid Current*	32	33	33 mA
Peak RF Grid Voltage*	110	110	110 volts
Driving Power*	3.5	3.8	3.8 watts
Plate Input Power	380	600	800 watts
Plate Output Power	240	425	600 watts

*Approximate values.

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	400 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID DISSIPATION	1 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	400	200	200 mA
Max-Signal DC Plate Current	800	790	750 mA
Max-Signal DC Screen Current	24	16	4 mA
Effective Load, Plate to Plate	2060	3000	5100 ohms
Peak AF Grid Input Voltage (per tube)*	55	65	60 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	340	800	890 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	400 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID DISSIPATION	1 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	200	100	100 mA
DC Plate Current	280	210	205 mA
DC Screen Current*	—5	—5	—5 mA
Peak RF Grid Voltage*	28	33	30 volts
Plate Output Power	52	110	115 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	400 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID DISSIPATION	1 MAX. WATTS

TYPICAL OPERATION (Peak-envelope conditions except where noted

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—60	—70	—70 volts
Zero-Signal DC Plate Current	200	100	100 mA
Peak RF Grid Voltage*	55	65	60 volts
DC Plate Current	400	395	375 mA
DC Screen Current*	12	8	2 mA
Plate Input Power	400	590	750 watts
Plate Output Power	170	400	415 watts
Two-Tone Average DC Plate Current			
Two-Tone Average DC Screen Current			

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	—250 MAX. VOLTS
DC PLATE CURRENT	300 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID DISSIPATION	1 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	1000	1500 volts
DC Screen Voltage	250	250 volts
DC Grid Voltage	—130	—130 volts
DC Plate Current	285	300 mA
DC Screen Current*	24	18 mA
DC Grid Current*	17	17 mA
Peak RF Grid Input Voltage*	148	148 volts
Driving Power*	1.7	1.7 watts
Plate Input Power	285	500 watts
Plate Output Power	165	300 watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance has been made for circuit losses. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variation in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4CX300Y may be operated in any position. Recommended sockets for the 4CX300Y are the Eimac Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater contact grounded). Both sockets provide connections to all electrodes except the anode and each incorporates a screen by-pass capacitor of approximately 1100 uuf. The SK-606 chimney is recommended for use with the SK-700 and SK-710 sockets.

Other sockets suitable for use with the 4CX300Y include the SK-740, SK-760, and SK-770. These sockets do not incorporate screen by-pass capacitors. The SK-760 and SK-770 incorporate integral air chimneys. Screen contacts are connected to the mounting flange in the SK-770 and are, therefore, grounded when the socket is installed in the usual manner.

Cooling—The maximum rated ceramic-to-metal seal temperature for the 4CX300Y is 250°C. Adequate forced-air cooling must be provided to assure that this maximum temperature rating is not exceeded. Airflow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
100	2.2	0.065	3.2	0.095
150	3.4	0.14	4.9	0.21
200	4.6	0.26	6.7	0.37
250	5.9	0.40	8.6	0.58
300	7.2	0.58	10.5	0.85
350	8.7	0.82	12.7	1.2
400	10.3	1.12	15.0	1.6

A new, more efficient cooling fin design is incorporated in the 4CX300Y which results in lower airflow requirements. This is reflected in the table above (which assumes the use of an Eimac SK-700 or SK-710 socket and SK-606 chimney).

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300Y is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

ELECTRICAL

Heater Operation—The rated heater voltage for the 4CX300Y is 6.0 volts.

The heater voltage must be maintained within ± 5% of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation—The 4CX300Y employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation—The 4CX300Y control grid has a maximum dissipation rating of 1.0 watt, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

In class-A and class-AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation—The maximum rated screen dissipation for the 4CX300Y is 8 watts. The maximum rated d-c screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated d-c values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

A screen by-pass capacitor of approximately 1100 uuf is incorporated in the body of the Eimac SK-700 and SK-710 Air-System Sockets and is adequate for normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require that additional capacitance be connected externally. In the latter case, the screen by-pass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300Y is above the useful high-frequency limit for the tube when either of the sockets with integral screen by-pass capacitors is used.

Plate Operation—The 4CX300Y has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300Y is 400 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB amplifier applications. When the 4CX300Y is used in plate-modulated amplifier applications, the plate-dissipation rating is 250 watts under carrier conditions, rising to 400 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

The maximum rated plate voltage for class-AB_1

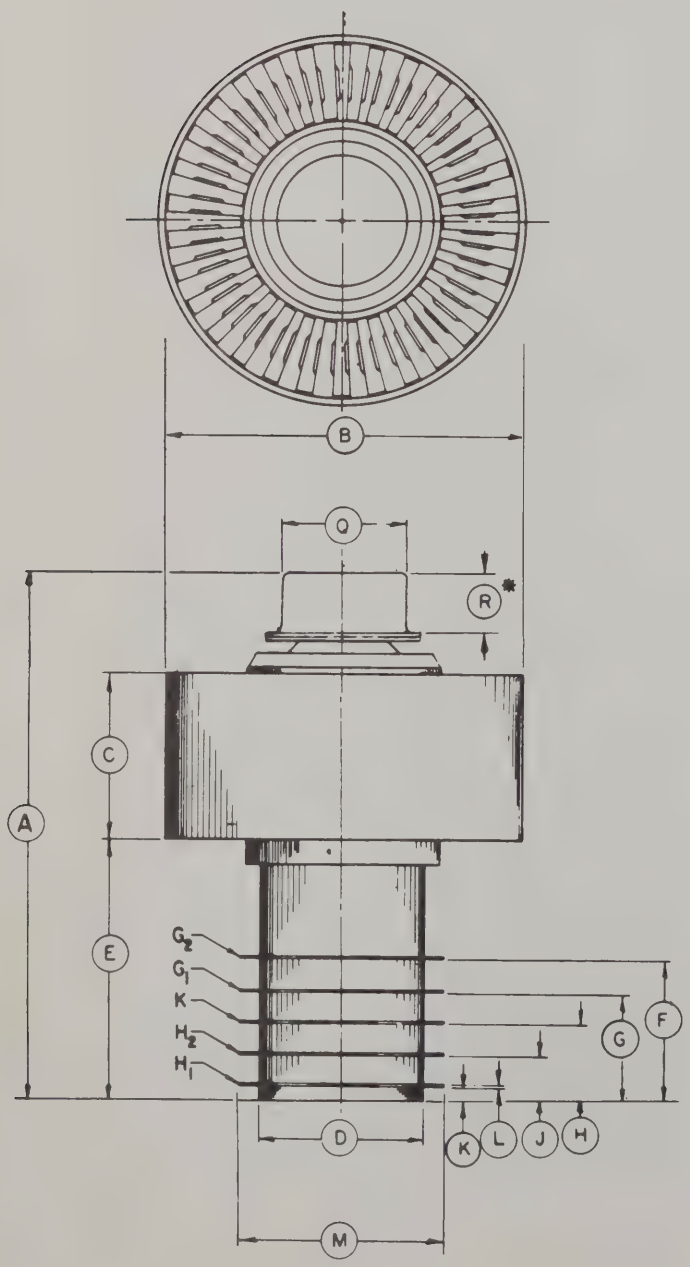
operation is 2000 volts. In class-C telegraphy and plate-modulated service the maximum rated plate voltage is 2000 and 1500 volts respectively.

Modulation—The 4CX300Y can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

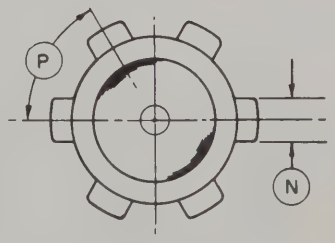
Plate modulation can be applied to the 4CX300Y when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation" above.

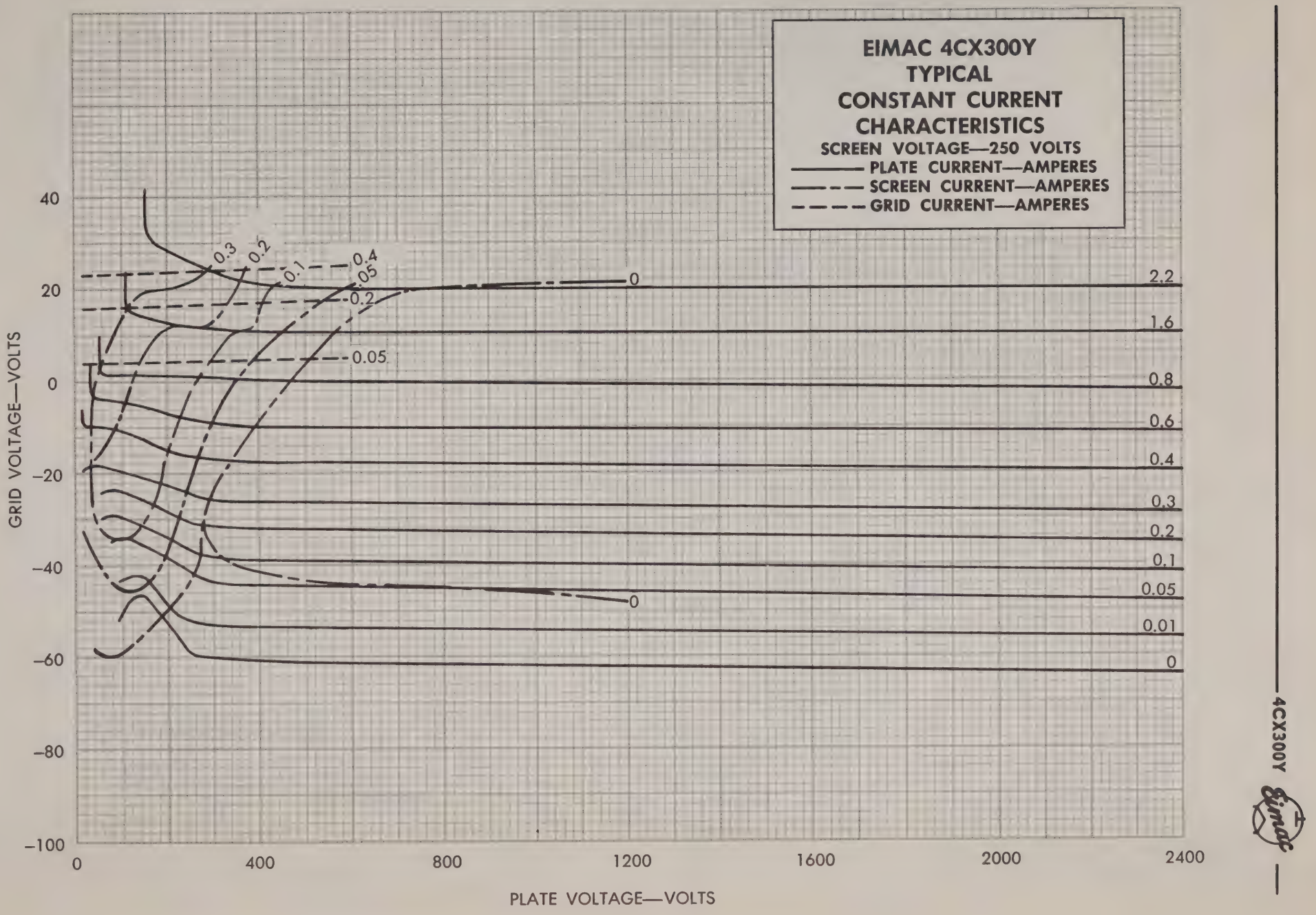
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

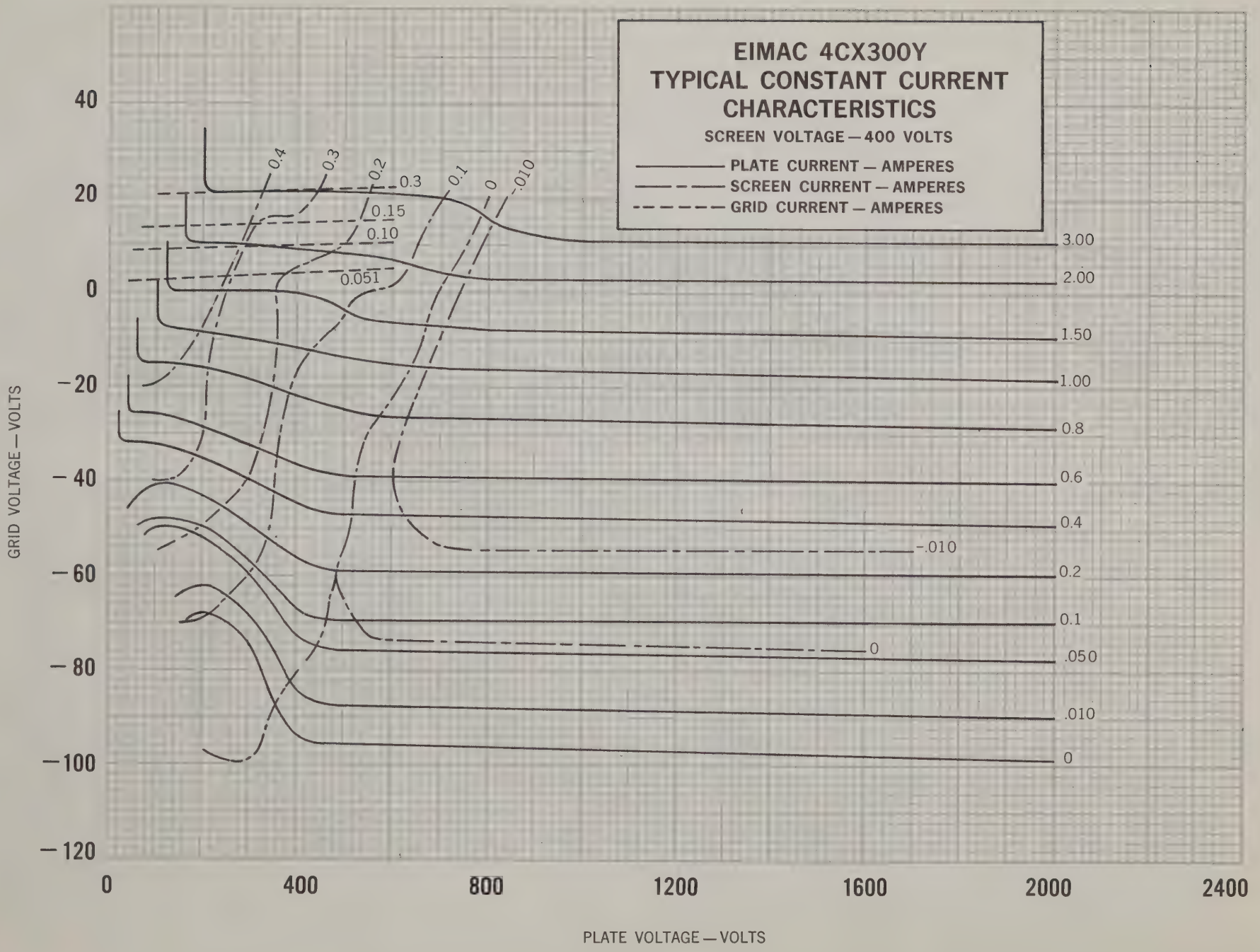


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		2.300	2.500
B		1.610	1.640
C		.710	.790
D		.740	.770
E		1.133	1.195
F		.602	.642
G		.470	.500
H		.329	.359
J		.193	.213
K		.050	.072
L		.010	.020
M		.936	.956
N		.170	.185
P	60°		
Q		.559	.573
R		.240	.280



*CONTACT SURFACE


EIMAC 4CX300Y
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE—250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
2400
0.3
0.2
0.1
0.4
0.05
0.2
0.05
0
0
2.2
1.6
0.8
0.6
0.4
0.3
0.2
0.1
0.05
0.01
0


EIMAC 4CX300Y
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100
−120
0
400
800
1200
1600
2000
2400
0.4
0.3
0.2
0.3
0.1
0
-.010
0.15
0.10
0.051
3.00
2.00
1.50
1.00
0.8
0.6
0.4
-.010
0.2
0.1
0
.050
.010
0

Eimac®

EITEL-McCULLOUGH, INC.

8168
4CX1000A

CERAMIC POWER TETRODE

The Eimac 8168/4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 r f linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1630 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3260 watts of audio power.



GENERAL CHARACTERISTICS

▶ ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.022	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	uuf
Output	11		13	uuf
Feedback			0.004	uuf
Frequency for Maximum Ratings			110	mc

*In shielded fixture.

▶ MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-800 Series
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (Approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER Class AB or B

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

▶ TYPICAL OPERATION (Frequencies below 30 Mc)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current*	890	885	875 mA
Two-Tone Average DC Plate Current	645	650	635 mA
Zero-Signal DC Screen Current*	8	6	5 mA
Single-Tone DC Screen Current*	35	35	35 mA
Two-Tone Average DC Screen Current*	10	8	8 mA
Plate Output Power	930	1300	1630 watts

*Approximate values.

[1]Adjust grid bias to obtain zero-signal plate current.

(Effective 11-4-63) © Copyright 1963 by Eitel-McCullough, Inc.

▶ Indicates change from data sheet dated 3-18-59

AUDIO AMPLIFIER OR MODULATOR Class AB$_1$

MAXIMUM RATINGS	
DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

▶ TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	500	500	500	mA
Max.-Signal DC Plate Current	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate	2040	2850	3680	ohms
Driving Power	0	0	0	watts
Max.-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

▶ **Cooling**—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes and at VHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation—The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five milliamperes as read on a five-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the 'Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

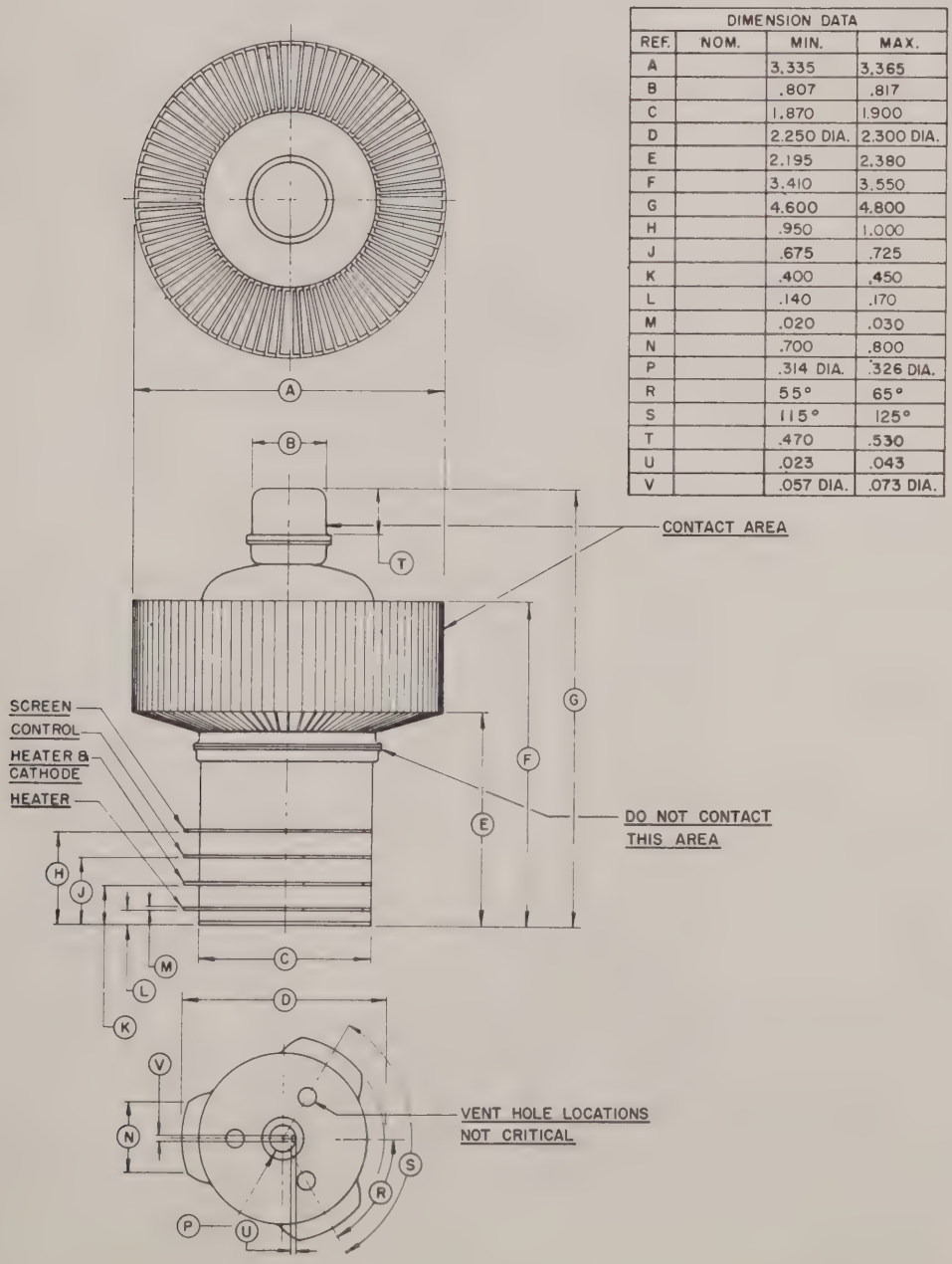
Plate Operation—The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

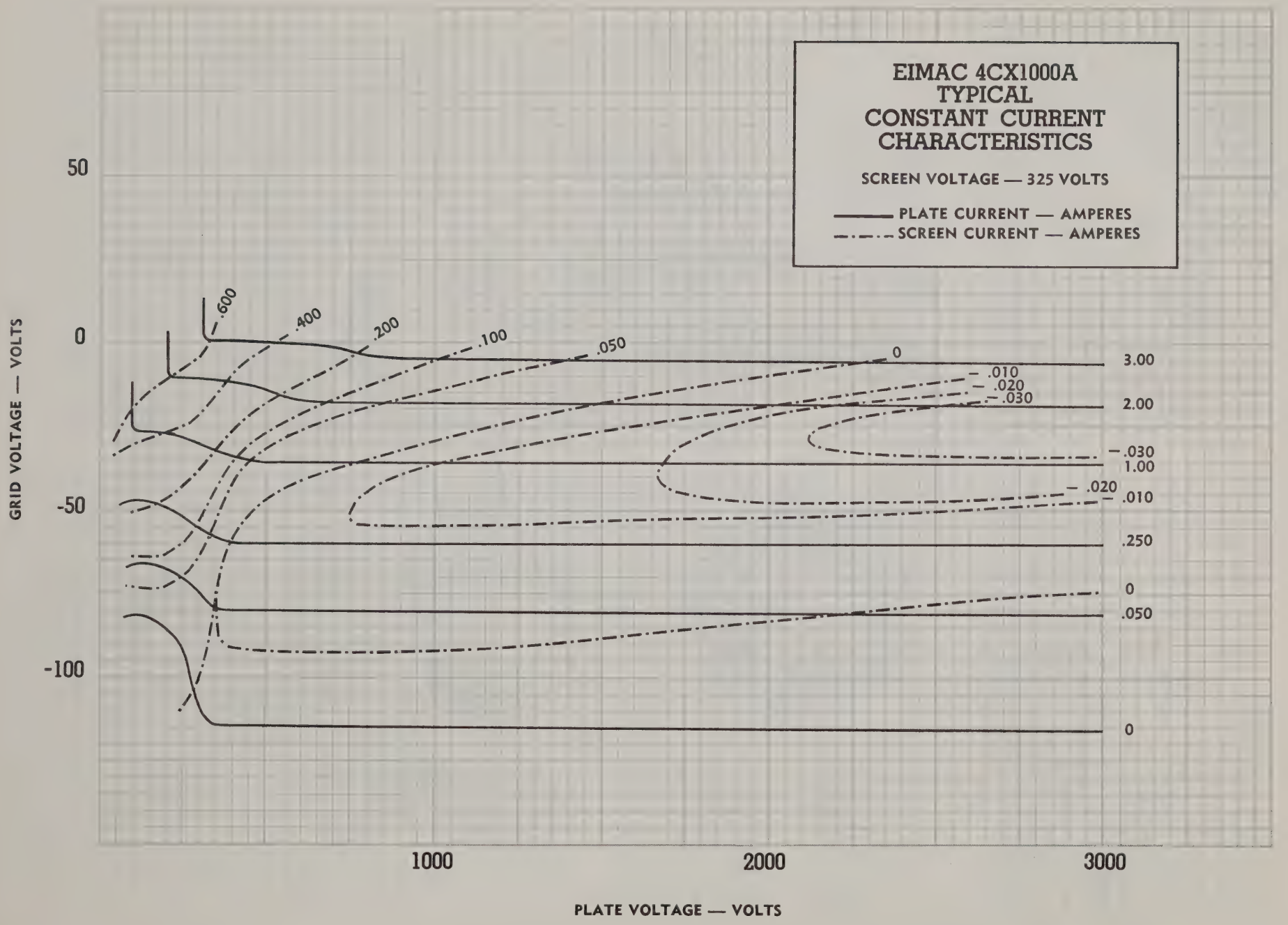
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.




EIMAC 4CX1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

8352
4CX1000K

CERAMIC
POWER TETRODE

The Eimac 8352/4CX1000K is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier applications where its high gain and low distortion characteristics may be used to advantage. The 8352/4CX1000K is similar to the 8168/4CX1000A but contains a solid screen ring that improves isolation between input and output circuits and permits use of the tube in UHF service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.022	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	uuf
Output	11		13	uuf
Feedback			0.004	uuf
Maximum Useable Frequency			400	Mc

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-820 or SK-830
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces

RADIO-FREQUENCY LINEAR AMPLIFIER—Class AB or B

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. WATTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current	890	885	875 mA
Two-Tone Average DC Plate Current	645	650	635 mA
Zero-Signal DC Screen Current*	8	6	5 mA
Single-Tone DC Screen Current*	35	35	35 mA
Two-Tone Average DC Screen Current*	10	8	8 mA
Plate Output Power	930	1300	1630 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

(Effective 1-1-64) © Copyright 1964 by Eitel-McCullough, Inc.

AUDIO AMPLIFIER OR MODULATOR Class AB₁

MAXIMUM RATINGS	
DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal DC Plate Current	500	500	500	mA
Max-Signal DC Plate Current	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate	2040	2850	3680	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

"TYPICAL OPERATION" data are obtained by calculation from published characteristic curves; NO ALLOWANCE is made for circuit losses. Adjustment of the grid bias to obtain the specific zero-signal plate current is assumed. The screen voltage required to obtain the listed value of maximum plate current, without drawing grid current, MAY VARY from the typical values shown. These conditions are valid to approximately 100 Mc. at higher frequencies, power output will be lower due to tube and circuit losses.

APPLICATION

MECHANICAL

Cooling—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes and at UHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CX1000K is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control Grid Operation—The grid dissipation rating of the 4CX1000K is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five milliamperes as read on a five-milliamperes meter may be permitted to flow for peak-signal monitoring purposes.

Screen Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000K and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000K is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the 'Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

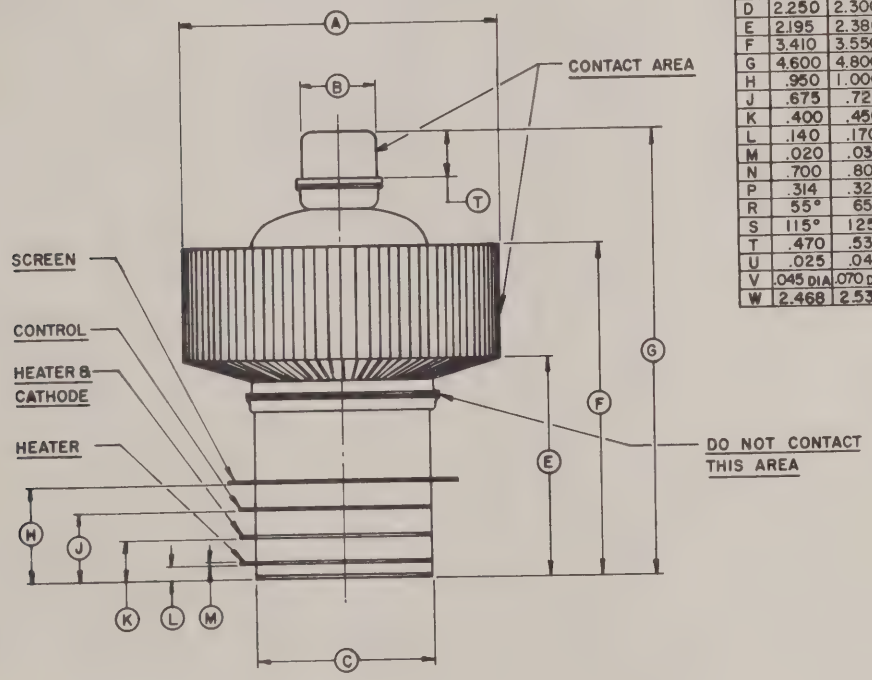
Plate Operation—The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

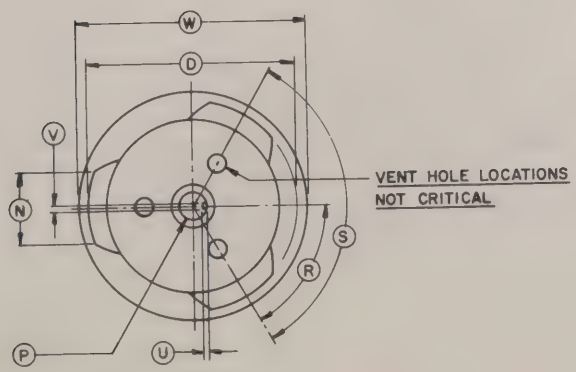
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

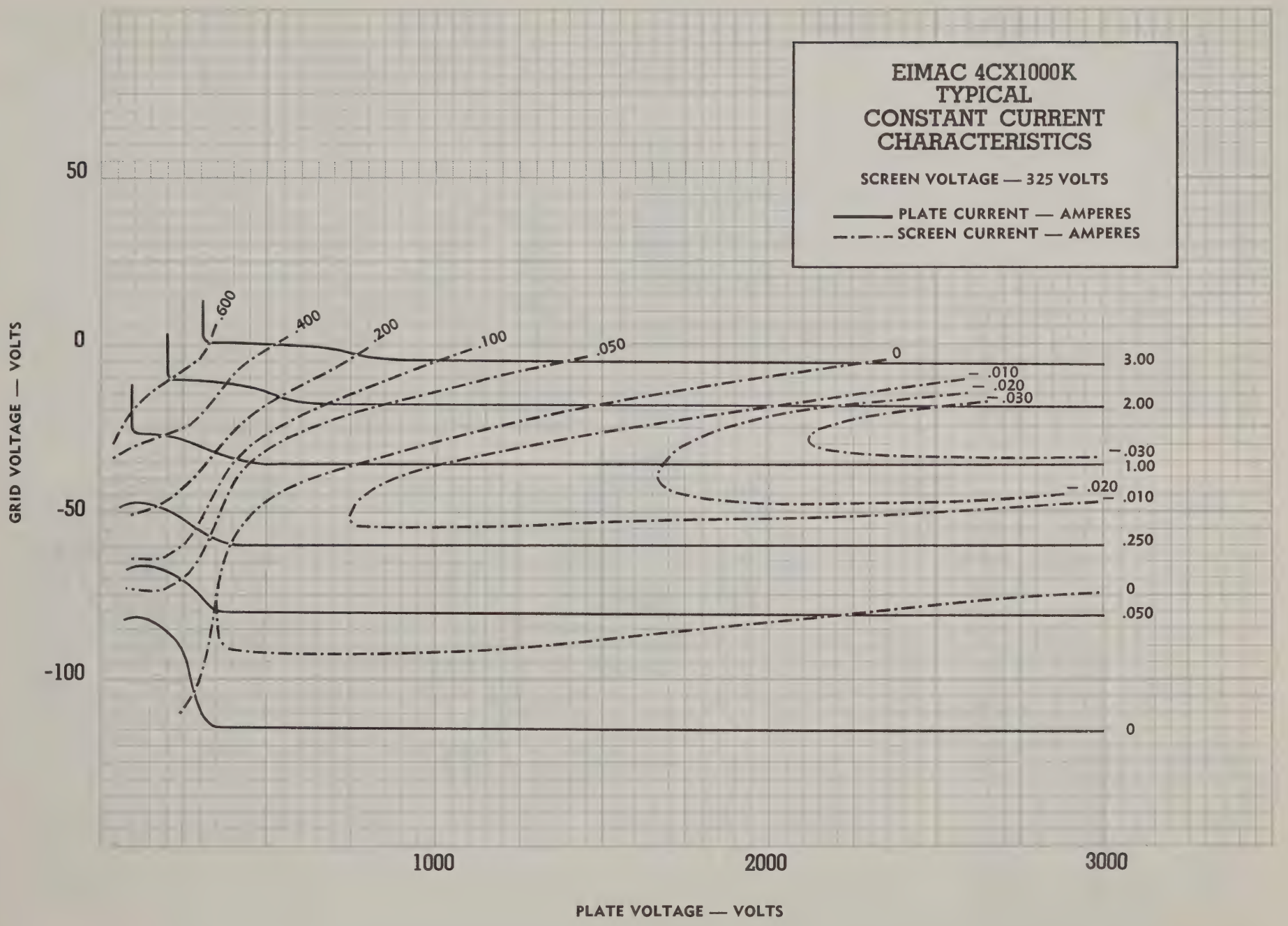
Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	3.335	3.365	
B	.807	.817	
C	1.870	1.900	
D	2.250	2.300	
E	2.195	2.380	
F	3.410	3.550	
G	4.600	4.800	
H	.950	1.000	
J	.675	.725	
K	.400	.450	
L	.140	.170	
M	.020	.030	
N	.700	.800	
P	.314	.326	
R	55°	65°	
S	115°	125°	
T	.470	.530	
U	.025	.048	
V	.045 DIA	.070 DIA	
W	2.468	2.531	






EIMAC 4CX1000K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

4X500A

RADIAL-BEAM POWER TETRODE

The Eimac 4X500A is an external-anode tetrode having a maximum plate dissipation rating of 500 watts. Its small size and low-inductance leads permit efficient operation at relatively large outputs well into the VHF region. The screen grid is mounted on a disc which terminates in a connector ring located between grid and plate, thus making possible effective shielding between the grid and plate circuits. The grid terminal is located at the center of the glass base to facilitate single-tube operation in coaxial circuits.

The combination of low grid-plate capacitance, low screen-lead inductance and functionally located terminals contributes to the stable operation of the 4X500A at high frequencies, making neutralization unnecessary in most cases and greatly simplifying it in others.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		5		volts
Current	12.2		13.7	amperes
Amplification Factor (Grid-to-Screen)	4.5		6.5	
Transconductance (I_b = 200 ma., E_b = 2500v., E_{c2} = 500v.)		5200		umhos
Direct Interelectrode Capacitances Grounded Cathode:				
Input	10.6		14.4	uuf
Output	4.9		6.9	uuf
Feedback			0.1	uuf
Frequency for Maximum Ratings			120	mc.

MECHANICAL

Base	Special 4 pin
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Anode Core	175° C
Recommended Socket	Eimac SK900
Operating Position	Vertical, base up or down
Maximum Dimension:	
Height	4.75 inches
Diameter	2.625 inches
Cooling (See following page)	Forced Air
Net Weight	1.7 pounds
Shipping Weight (Approximate)	6 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C FM or Telegraphy (Key-down conditions, 1 tube)
MAXIMUM RATINGS (Frequencies up to 120 Mc.)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	500 MAX. WATTS
SCREEN DISSIPATION	30 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Per tube, at 110 Mc.)

D-C Plate Voltage	2500	3000	4000	Volts
D-C Plate Current	310	310	315	Ma.
D-C Screen Voltage	500	500	500	Volts
D-C Screen Current	26	24	22	Ma.
D-C Grid Voltage	—150	—150	—150	Volts
D-C Grid Current	15	16	16	Ma.
Driving Power (approx.)	5	5	5	Watts
Useful Power Output (approx.)	475	600	835	Watts

(Effective 1-1-64) © Copyright 1961, 1964 by Eitel-McCullough, Inc.

RADIO FREQUENCY POWER AMPLIFIER

Class-B Linear Amplifier,
Television Visual Service

MAXIMUM RATINGS (Frequencies below 220 mc.)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
PLATE DISSIPATION	500 MAX. WATTS
SCREEN DISSIPATION	30 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION

(Per tube at peak synchronizing level, 5-Mc. bandwidth, assumed load resistance 3,000 ohms per tube.)[1]

D-C Plate Voltage	1850	2400	Volts
D-C Screen Voltage	500	500	Volts
D-C Grid Voltage	—100	—100	Volts
D-C Plate Current	285	400[1]	Ma.
D-C Screen Current (approx.)	20	35	Ma.
D-C Grid Current (approx.)	10	15	Ma.
Peak R-F Grid Voltage	140	185	Volts
Driving Power, 220 Mc. (approx.)	15	25	Watts
Plate Power Input	525	960	Watts
Power Output	300	600	Watts
BLACK LEVEL			
D-C Plate Current	215	300	Ma.
D-C Screen Current	2	3	Ma.
D-C Grid Current	2	5	Ma.
Plate Power Input	400	720	Watts
Plate Dissipation	230	380	Watts
Power Output	170	340	Watts

[1] Operating conditions at peak synchronizing level may be permitted to exceed maximum ratings of the tube because of the low duty factor. Maximum ratings apply to black level conditions.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X500A must be operated vertically. The base may be down or up. The recommended socket for this tube is the SK-900 Air-System Socket.

Cooling—Forced-air cooling must be provided to hold the glass-to-metal seals and the anode cooler core below the maximum rated temperature of 150°C.

A flow rate of 20 cfm will be adequate for operation at sea level and with an inlet air temperature up to 50°C. Under these conditions, 20 cfm of air flow corresponds to a pressure difference across the tube and SK-900 socket of 2.25 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes increased air flow will be required. For example, at an altitude of 10,000 feet, a flow-rate of 29 cfm will be required and will be obtained with a pressure drop across tube and socket of 3.25 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and at the particular altitude.

The pressure drop figures indicated above are those measured directly at the air gage hole in the SK-900 air system socket. In the event that a socket is not used, and a plenum pressure drop measurement is required, this plenum pressure drop rating must equal the pressure drop figures indicated above multiplied by 1.5 for the specific application.

ELECTRICAL

Filament Operation—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Control Grid Operation—The d-c voltage for the 4X500A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

Screen Grid Operation—Power dissipated by the screen of the 4X500A must not exceed 30 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 30 watts in event of circuit failure.

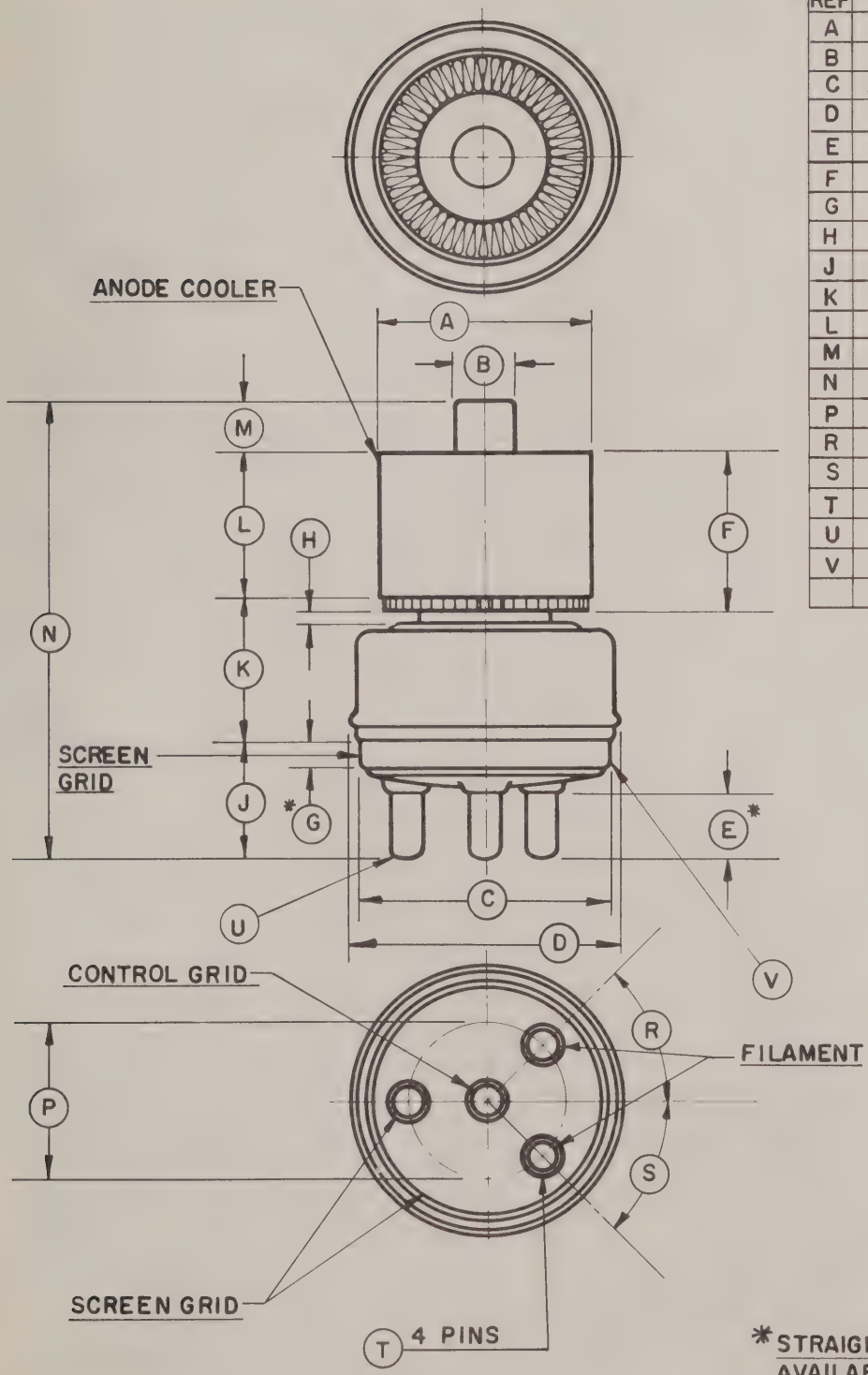
Plate Operation—The maximum rated plate-dissipation power is 500 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

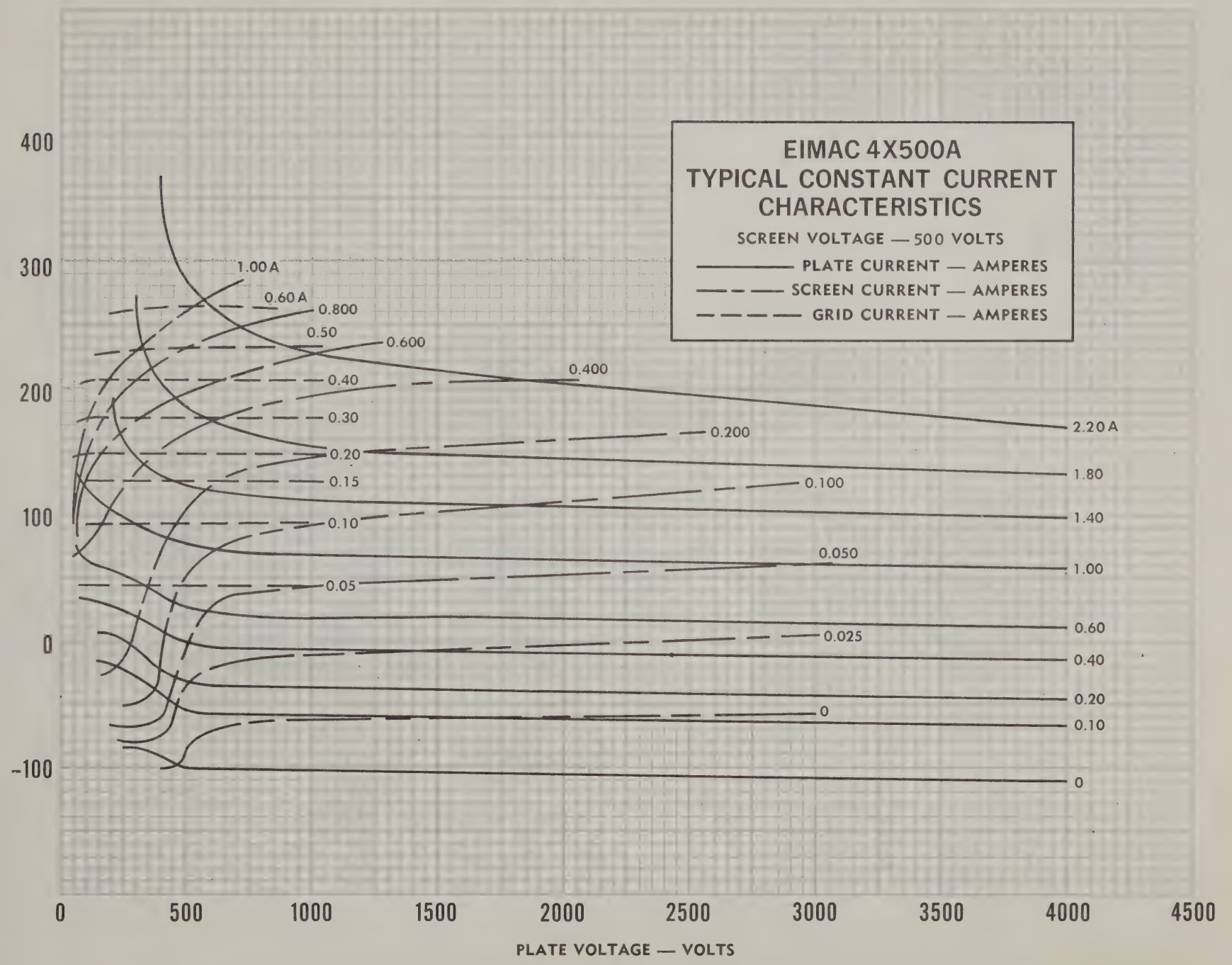
Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

DIMENSIONS IN INCHES		
REF	MIN.	MAX.
A	1.980	2.020
B	.559	.573
C	2.365	2.385
D		2.625
E	.500	
F	1.438	1.562
G	.156	
H	.062	
J	1	1.125
K	1.406	1.594
L	1.344	1.406
M	.438	.562
N	4.250	4.750
P	1.490	1.510
R	44°	46°
S	44°	46°
T	.308	.318
U	.031R	
V	.094R	



*STRAIGHT SIDE AVAILABLE FOR CONTACT



Printed in U.S.A. 973

Eimac®

EITEL-McCULLOUGH, INC.

X-1149

REFLEX KLYSTRON

OPERATING FREQUENCY
12.4 to 18 Gc

OUTPUT POWER
1.2 to 2 Watts

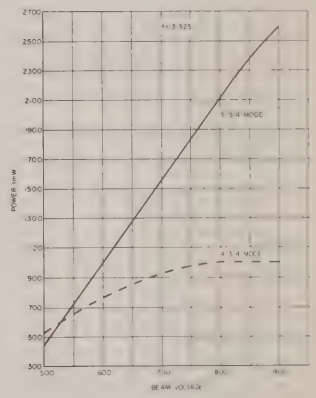


KU BAND

TYPICAL PERFORMANCE

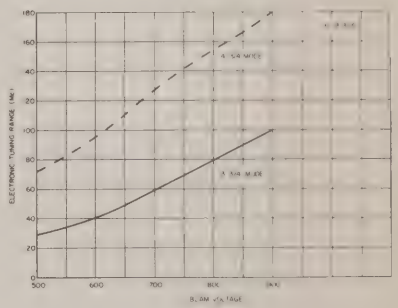
ELECTRICAL

Frequency Range	12-15 Gc
	15-18 Gc
Output Power	(1.2 Watts (Min.) to 2 Watts
	(1.0 Watts (Min.) to 1.5 Watts
Beam Voltage	800 Vdc
Mechanical Tuning Range	±50 Mc to ±200 Mc
Cathode Current	95 mAdc Max.
Repeller Voltage	-50 to -400 Vdc
3 db Bandwidth	70 Mc
Modulation Sensitivity	.6 - .9 Mc/V
Temperature Coefficient	±200 Kc/°C
Heater Voltage (AC)	6.3 V
VSWR	1.2:1 Max.
Mode	3-3/4



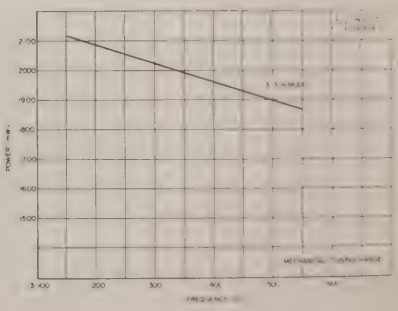
MECHANICAL

Operating Position	Any
Mounting	Waveguide flange
Output Coupling, rf	RG/91U
Cooling	Convection
Net Weight	7 oz.



ENVIRONMENTAL

Maximum Ambient Temperature	150°C
Maximum Altitude	No limit
Maximum Shock	40g (11 MS duration)
Maximum Operating Vibration	10G (20-2000 cps)



APPLICATIONS

1. Doppler Navigator
2. Radar Altimeter
3. Paramp Pump (multiple)
4. Microwave Data Link
5. Terrain Clearance (avoidance) Radar

(Effective 1-1-64) © Copyright 1964 by Eitel-McCullough, Inc. Printed in U.S.A.

APPLICATION NOTES

1. **COOLING:** The X-1149 may be cooled by conduction if the connecting waveguide flange provides an adequate heat-sink to maintain the tube body temperature below the maximum rating of 150° Centigrade. At high ambient temperatures, forced air cooling may be required to operate within this rating. For maximum tube life, the tube body temperature should be less than 100° Centigrade. Normal operating conditions will require convection cooling to maintain desired body temperatures.

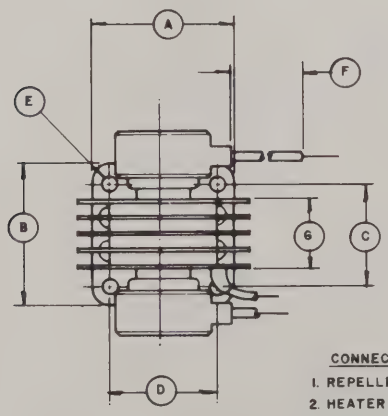
2. **RESONATOR:** The resonator of the X-1149 is integral with the body of the klystron. For this reason it is often convenient to operate the resonator at chassis potential, with the repeller and cathode at appropriate negative potentials.

3. **CATHODE:** The heater voltage should be maintained with ±5% of the rated value of 6.3 volts if variations in performance are to be minimized and best tube life obtained.

   The heater and cathode of the X-1149 are internally connected. When the resonator of this tube is operated at chassis potential, the heater transformer must be insulated for the cathode-to-resonator voltage.

4. **SHOCK AND VIBRATION:** This klystron is specifically designed for use in applications encountering vibration and shock extremes. This tube is capable of delivering its rated power output when subjected to vibration levels of 10g (20-2000 cps) or shock of up to 40g (11 milliseconds duration.)

   With a vibration level of 10g in any reference plane, the peak-to-peak FM deviation will be less than 100 kilocycles.



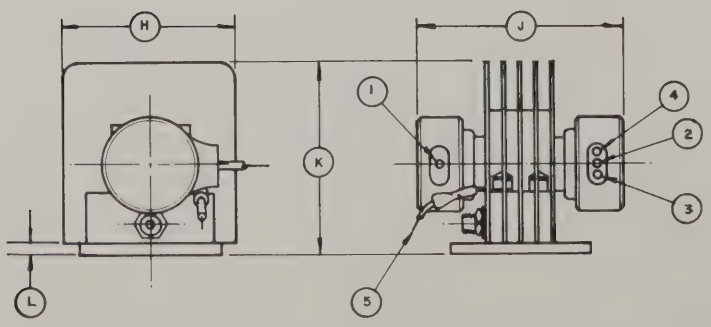
DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A			1.312
B			1.312
C	.952	.960	
D	.990	.998	
E	.143 D.	.148 D.	
F	12±1 TYP. LEAD LENGTH		
G			.650
H			1.600
J		2.100	
K		1.500	
L			.125

CONNECTIONS

1. REPELLER - GREY
2. HEATER - YELLOW
3. CATHODE - GREEN
4. HEATER CATHODE - WHITE
5. GROUND - BROWN



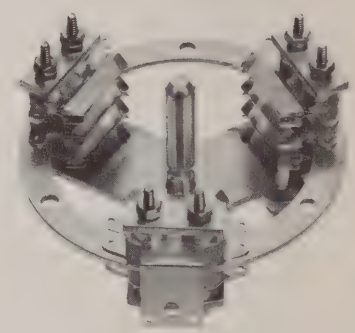
EITEL-McCULLOUGH, INC.

SK-860
SK-870

AIR-SYSTEM SOCKETS

The Eimac SK-860 and SK-870 are air-system sockets recommended for use with the Eimac 3CX1000A7 triode. A companion SK-816 Air Chimney is also available and is recommended for use with the socket.

When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-860 and SK-870 are humidity and salt-spray resistant.



BASE CONNECTIONS

The SK-860 and SK-870 sockets consist of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact) and a center guide to facilitate tube installation. The terminals are shown on the outline drawing.

No contacts are grounded on the SK-860, while the SK-870 has the grid contacts grounded to the equipment chassis when installed.

MATERIALS and FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are of nickel-plated brass. All contacts are formed of a non-ferrous alloy, heat treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-860 and SK-870 are designed for under-chassis mounting and require a 5-1/16" hole through the chassis deck. The socket is held in place by the six 4-40 studs provided on the socket. The grid of the SK-870 is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

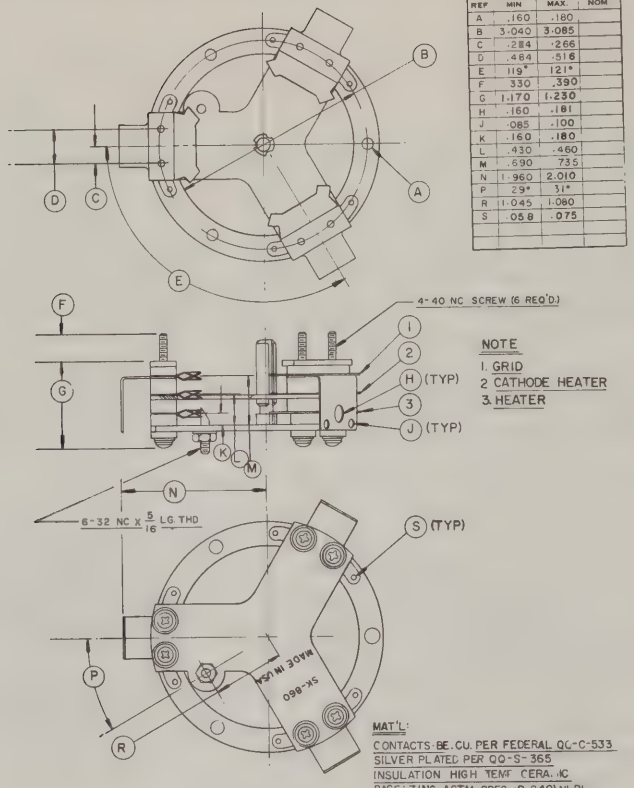
The SK-816 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-860 and SK-870.

NET WEIGHT . . . . . 12 ounces

(Effective 5-9-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF	MIN	MAX.	NOM
A	.160	.180	
B	3.040	3.085	
C	.234	.266	
D	.484	.516	
E	119°	121°	
F	330	.390	
G	1.170	1.230	
H	.160	.181	
J	.085	.100	
K	.160	.180	
L	.430	.460	
M	.690	.735	
N	1.960	2.010	
P	29°	31°	
R	1.045	1.080	
S	.058	.075	



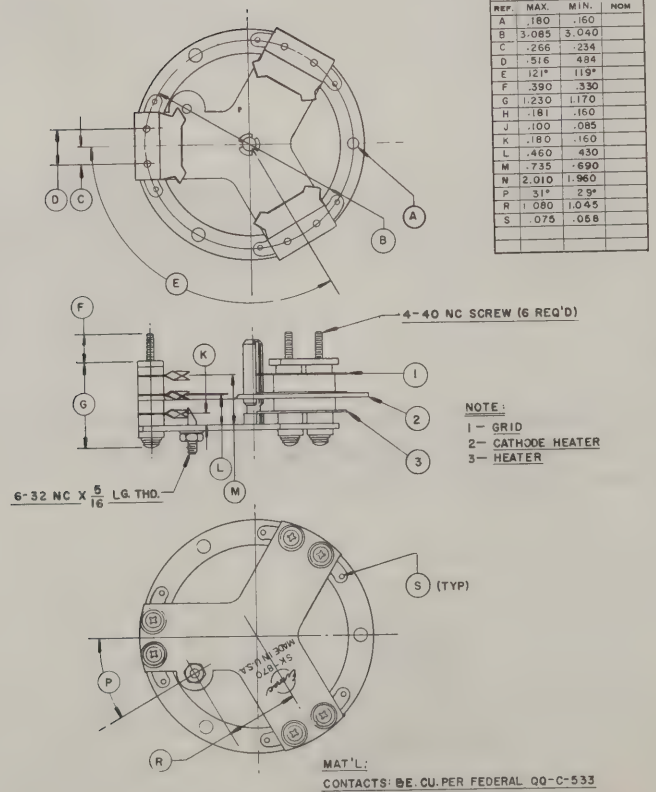
NOTE
1. GRID
2 CATHODE HEATER
3. HEATER

MAT'L:
CONTACTS: BE. CU. PER FEDERAL QQ-C-533
SILVER PLATED PER QQ-S-365
INSULATION HIGH TEMP. CERAMIC
BASE: ZINC ASTM SPEC. (B-240) NI. PL.
PER QQ-N-290 CLASS 1, TYPE IX
SCREWS. BRASS, NI. PL. PER QQ-N-290
CLASS 1, TYPE VI

SK-860

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MAX.	MIN.	NOM
A	.180	.160	
B	3.085	3.040	
C	.266	.234	
D	.516	.484	
E	121°	119°	
F	.390	.330	
G	1.230	1.170	
H	.181	.160	
J	.100	.085	
K	.180	.160	
L	.460	430	
M	.735	.690	
N	2.010	1.960	
P	31°	29°	
R	1.080	1.045	
S	.075	.058	



NOTE:
1 — GRID
2— CATHODE HEATER
3— HEATER

MAT'L:
CONTACTS: BE. CU. PER FEDERAL QQ-C-533
SILVER PLATED PER QQ-S-365
INSULATION: HIGH TEMP. CERAMIC
BASE: ZINC ASTM SPEC. (B-240) NI. PL. PER
QQ-N-290 CLASS 1, TYPE IX
SCREWS: BRASS, NI. PL. PER QQ-N-290
CLASS 1, TYPE VI

SK-870

Eimac®

EITEL-McCULLOUGH, INC.

WL-150

WATER LOAD

The Eimac WL-150 water load provides a convenient means for dissipating radio frequency power in the 250 to 750 megacycle frequency range. The power dissipated by this load can also be readily measured by calorimetric methods.* The WL-150 will dissipate any power that can be transmitted by 6 1/8", 50-ohm, coaxial transmission line, and will introduce a low VSWR when terminating such a line. By using a waveguide-to-coaxial transition, the WL-150 can also be used with systems employing waveguide coupling. When used in this manner the WL-150 has been successfully operated at 300 kilowatts average power, and 5 megawatts peak power, at 425 megacycles.

Curves of VSWR vs frequency are shown for two fluids; (1) tap water and (2) a solution of 60% ethylene glycol and 40% distilled water. These fluids were chosen as being suitable for the majority of applications. The chemical composition of tap water undoubtedly varies in different locations, but in most cases it has relatively high conductivity at radio frequencies, and is therefore suitable for use in water loads. Minor variations in VSWR may, however, be expected when using tap water from different sources. Ethylene glycol is also adequately conductive at radio frequencies, and will provide the required losses regardless of the purity of the distilled water with which it is used.

Use of distilled water alone in the WL-150 is not recommended, as it does not have the required loss characteristics at radio frequencies. The two conventional methods of rating distilled water, in ohms per cubic centimeter, and in parts of impurities per million, have little bearing on the conductivity of water at radio frequencies. If distilled water must be used with the WL-150 a rust inhibitor additive such as sodium di-chromate (500 parts per million) should be employed to provide suitable radio frequency conductivity.

The VSWR measurements shown on the attached curves were made with a fluid temperature of approximately 25° C. Because the radio frequency conductivity of the fluid changes somewhat with temperature, corresponding changes in VSWR will result. Although the WL-150 will operate up to 70° C outlet temperature, for best VSWR the fluid temperature should be kept as low as possible.

CHARACTERISTICS

ELECTRICAL

Frequency Range	250 to 750 megacycles
Maximum VSWR (Tap Water)	1.06:1
Maximum VSWR (60% Ethylene Glycol Solution)	1.10:1

* When the fluid is water the power formula is:

Power (kw) = 0.264 x Flow-rate (gpm) x Temperature Rise (°C).

Typical values of the constant in this formula for the 60% ethylene-glycol solution are: 0.208 at 15° C, 0.215 at 40° C, and 0.226 at 70° C.

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

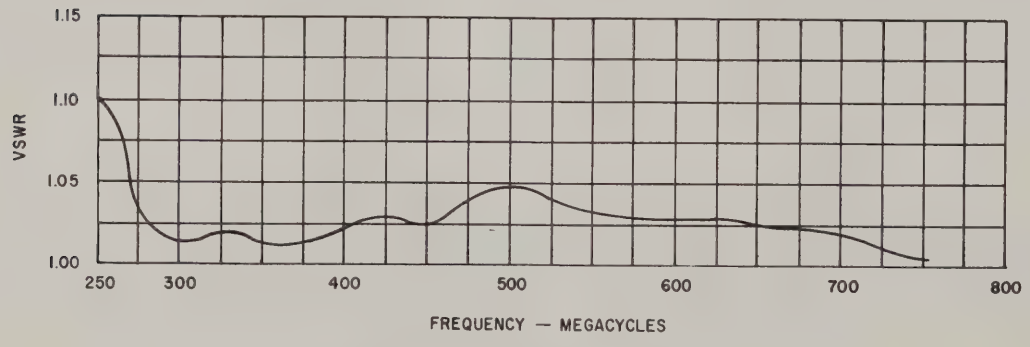
MECHANICAL

Operating Position	Horizontal or rf input end down
RF Coupling	6 1/8 inch EIA Flange
Coolant Connections	3/4" N.P.T. or 1" I.D. Hose
Maximum Static Fluid Pressure	60 psig
Maximum Outlet Fluid Temperature	70 °C
Typical Water Flow (100 Kilowatts Dissipation)	25 gpm
Maximum Length	86.75 inches
Fluid Capacity	7.5 gallons
Weight (empty)	78 pounds
Weight (with water)	140.5 pounds

For additional information or information regarding any specific application, write to Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California.

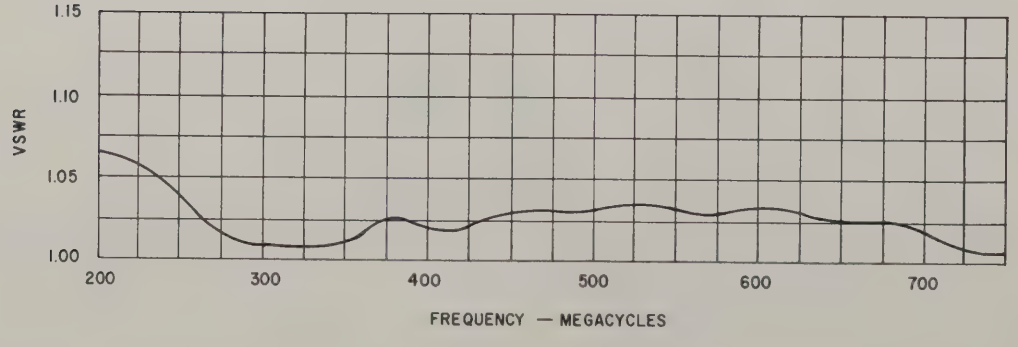
EIMAC WL-150 WATER LOAD

FLUID MIXTURE
60% ETHYLENE GLYCOL (PURE)
40% DISTILLED WATER



EIMAC WL-150 WATER LOAD

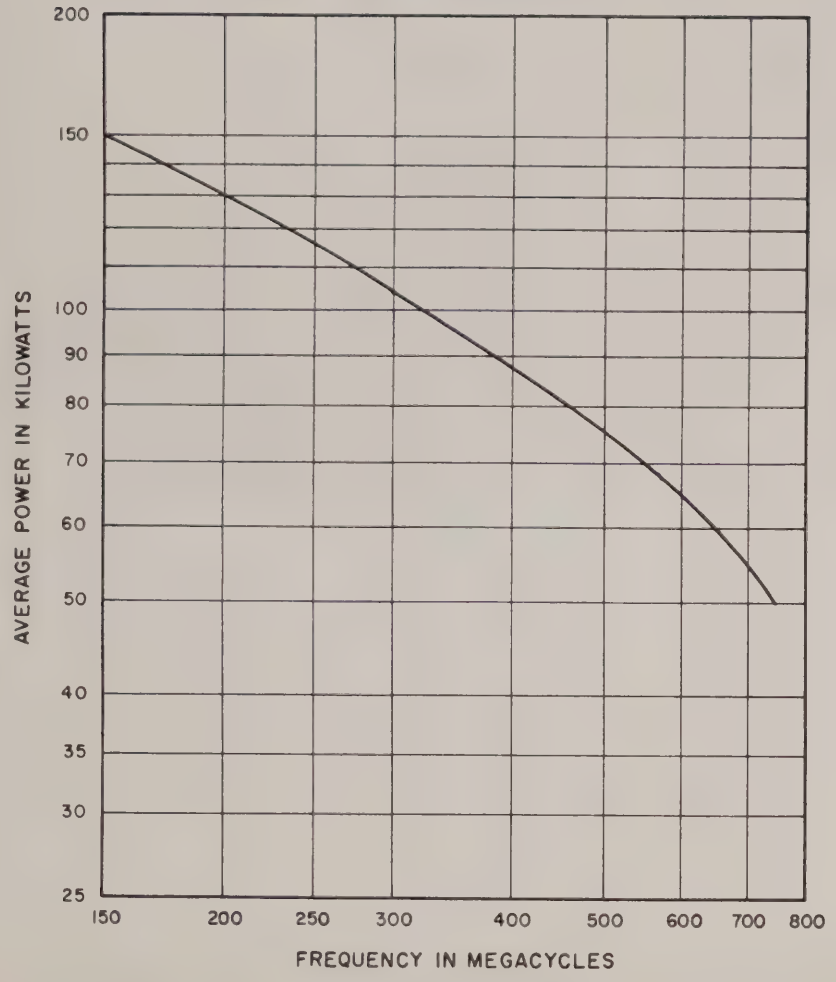
FLUID — TAP WATER



MAXIMUM AVERAGE POWER Vs. FREQUENCY

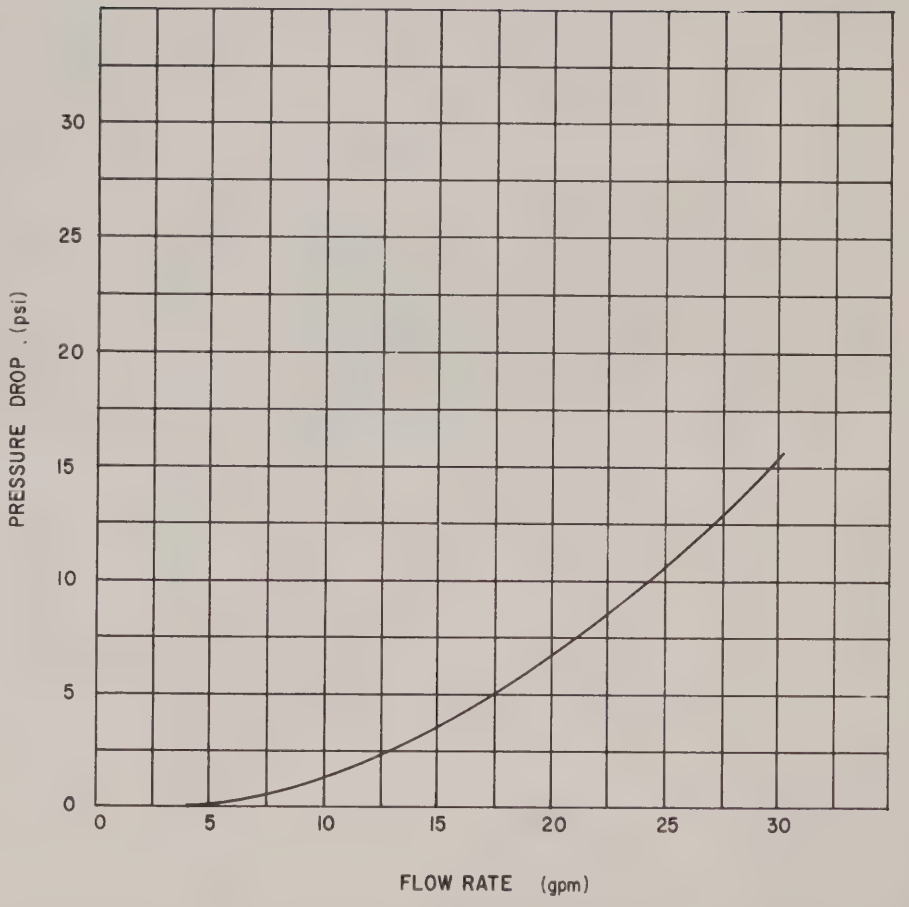
$6\frac{1}{8}$", 50-OHM RIGID COPPER TRANSMISSION LINE

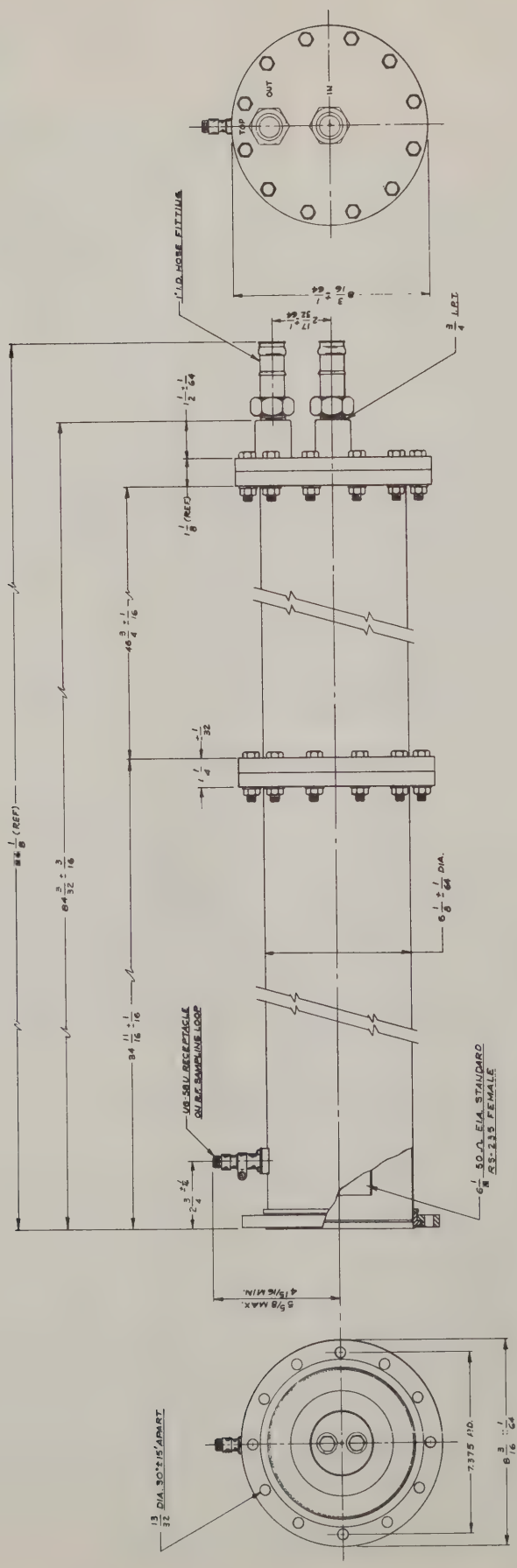
40°C AMBIENT TEMPERATURE AND UNITY VSWR.
(MAXIMUM INNER CONDUCTOR TEMPERATURE · 100°C)



EIMAC WL 150 WATER LOAD

PRESSURE DROP VS FLOW RATE FOR WATER





EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

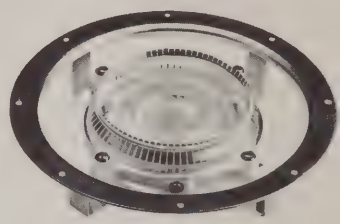
WL-150 WATER LOAD

Eimac®

EITEL-McCULLOUGH, INC.

SK-1300

AIR-SYSTEM SOCKET



The Eimac SK-1300 Air-System Socket has been designed for use with the tube types listed at the bottom of this sheet. The socket is intended for mounting on a pressurized chassis or plenum, allowing air-cooling of the tube base and terminals.

BASE CONNECTIONS

The SK-1300 Air-System Socket is provided with three concentric rings of spring contact fingers for making contact to the filament and the grid of the coaxial triodes listed below.

The filament contact fingers are terminated on two bus connections to insure good high frequency current distribution. Each of these two bus rings is provided with two lugs for making external connections.

The grid spring-finger contacts are terminated on a heavy support assembly. This assembly is in turn fitted with four 6-32 brass screws equally spaced around the periphery for grid circuit connections. The grid contact assembly is insulated from the socket cup.

MATERIALS AND FINISHES

The contact fingers are a non-ferrous spring alloy, heat-treated for positive spring action and silver-plated for good rf conductivity. The socket body and socket cup (support ring) are made of silver-plated brass.

INSTALLATION

The SK-1300 is supported by the socket cup on a pressurized compartment or chassis. A 7-1/8" diameter hole is required in the supporting chassis or plenum and the socket is secured by eight #6 machine screws on a 7-3/4" pitch circle.

The socket cup is open so that air may be directed through it for cooling of the base terminals.

CHIMNEY

A companion air-chimney, the SK-1306, is available for use with the SK-1300 and the air-cooled tubes 3CX10,000A1, 3CX10,000A3 and 3CX10,000A7 listed below. The chimney is mounted above the chassis deck and is installed using the same eight mounting screws used for securing the SK-1300 socket.

Use of the air chimney allows simplified cooling of the tube; air forced through the socket is directed through the air chimney and then through the tube's anode cooling fins.

The SK-1300 is used with the following tubes:

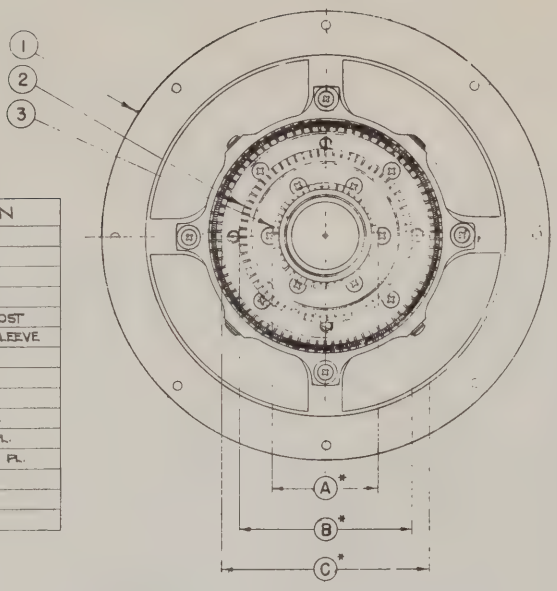
3CX10,000A1	3CW20,000A1	3CV30,000A3*
3CX10,000A3	3CW20,000A3	
3CX10,000A7	3CW20,000A7	

*Where a "floating" socket is desired, the SK-1310 should be used.

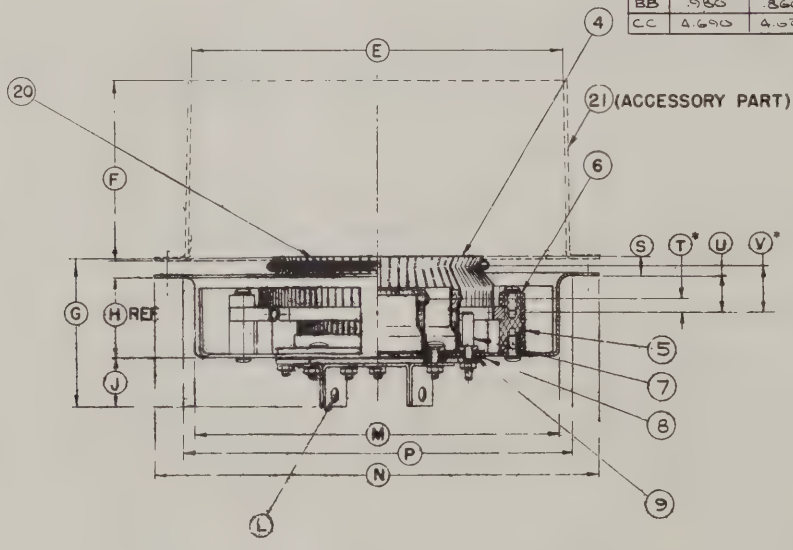
NET WEIGHT . . . . . 1.3 pounds

Effective (5-9-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

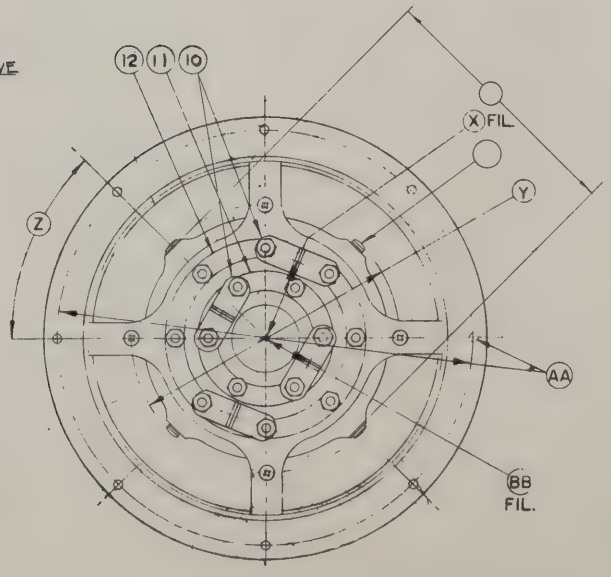
NO.	PART NO.	DESCRIPTION
1	115597	CUP, SOCKET
2	001838	OUTER FIL. COLLET
3	001837	INNER FIL. COLLET
4	115594	COLLET, GRID, ASS'M.
5	115596	INSULATOR, STAND-OFF, POST
6	115595	INSULATOR, STAND-OFF, SLEEVE
7	001825	STOP POST
8	001820	INSULATOR - FIL. COLLET
9	001834	INSULATOR-WASHER
10	115782	FILAMENT CONNECTOR
11	001808	INNER FILAMENT BUSS RING FIL.
12	001809	OUTER FILAMENT BUSS RING FIL.
13		6-32 UNC SCREW
20	001870	SPRING
21	115599	CHIMNEY



DIMENSION DATA			
REF.	MAX.	MIN.	NOM.
A	2.070	1.990	
B	3.320	3.240	
C	3.770	3.700	
E	7.125	7.030	
F	3.690	3.590	
G	2.835	2.710	
H	1.530	1.440	
J	.960	.890	
L	1/4 DIA. HOLE		
M	6.760	6.720	
N	8.280	8.220	
P	7.190	7.060	
S	.395	.270	
T	.285	.185	
U	.700	.580	
V	.865	.760	
X	1.620	1.500	
Y	5.030	4.970	
Z	47°	43°	
AA	*26(147) DIA. 8 HOLES ON 7 1/4 DIA P.C.		
BB	.980	.860	
CC	4.690	4.630	



NOTES:
1- ALL DIMENSIONS ARE IN INCHES
2- TOLERANCES ARE NOT CUMULATIVE
3- * CONTACT SURFACES



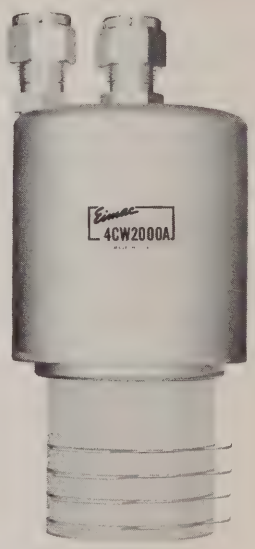
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

8244
4CW2000A

CERAMIC POWER TETRODE

The Eimac 8244/4CW2000A is a ceramic and metal, water cooled, radial-beam tetrode with a rated maximum plate dissipation of 2000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 r-f linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. The 4CW2000A is also recommended for voltage or current regulator service. As a regulator, up to 6000 volts of tube drop or one ampere of plate current can be realized.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.022	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	uuf
Output	11		13	uuf
Feedback			0.004	uuf
Frequency for Maximum Ratings			110	mc

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Recommended Socket	Eimac SK-800 Series
Operating Position	Vertical
Maximum Over-All Dimensions:	
Height	5.54 inches
Diameter	2.66 inches
Net Weight	27 ounces

RADIO-FREQUENCY LINEAR AMPLIFIER Class AB or B

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	2000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	250	250	250 mA
Single-Tone DC Plate Current	890	885	875 mA
Two-Tone Average DC Plate Current	645	650	635 mA
Zero-Signal DC Screen Current*	8	6	5 mA
Single-Tone DC Screen Current*	35	35	35 mA
Two-Tone Average DC Screen Current*	10	8	8 mA
Plate Output Power	930	1300	1630 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

AUDIO AMPLIFIER OR MODULATOR Class AB,

MAXIMUM RATINGS	
DC PLATE VOLTAGE	3000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	2000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	2000	2500	3000 volts
DC Screen Voltage	325	325	325 volts
DC Grid Voltage[1]	—60	—60	—60 volts
Zero-Signal DC Plate Current	500	500	500 mA
Max.-Signal DC Plate Current	1.78	1.77	1.75 amps
Zero-Signal DC Screen Current*	16	12	10 mA
Max-Signal DC Screen Current*	70	70	70 mA
Effective Load, Plate to Plate	2040	2850	3680 ohms
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	1860	2600	3260 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

Anode cooling is accomplished by circulating water through the integral water jacket. The tabulation below lists the minimum water flow requirements for 25°C inlet water temperature.

Plate Dissipation (Watts)	Water Flow (gpm)	Pressure Drop (psi)
1000	0.5	0.25
2000	1.5	1.25

Water pressure should never exceed 50 psi and outgoing water temperature must be limited to 70°C.

At ambient temperatures of 25°C, or less, when mounted in an Eimac SK-800B socket, the 4CW2000A does not require base cooling. At higher temperatures, however separate base cooling may be required.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CW2000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation—The grid dissipation rating of the 4CW2000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five millamperes as read on a five-milliamperes meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CW2000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

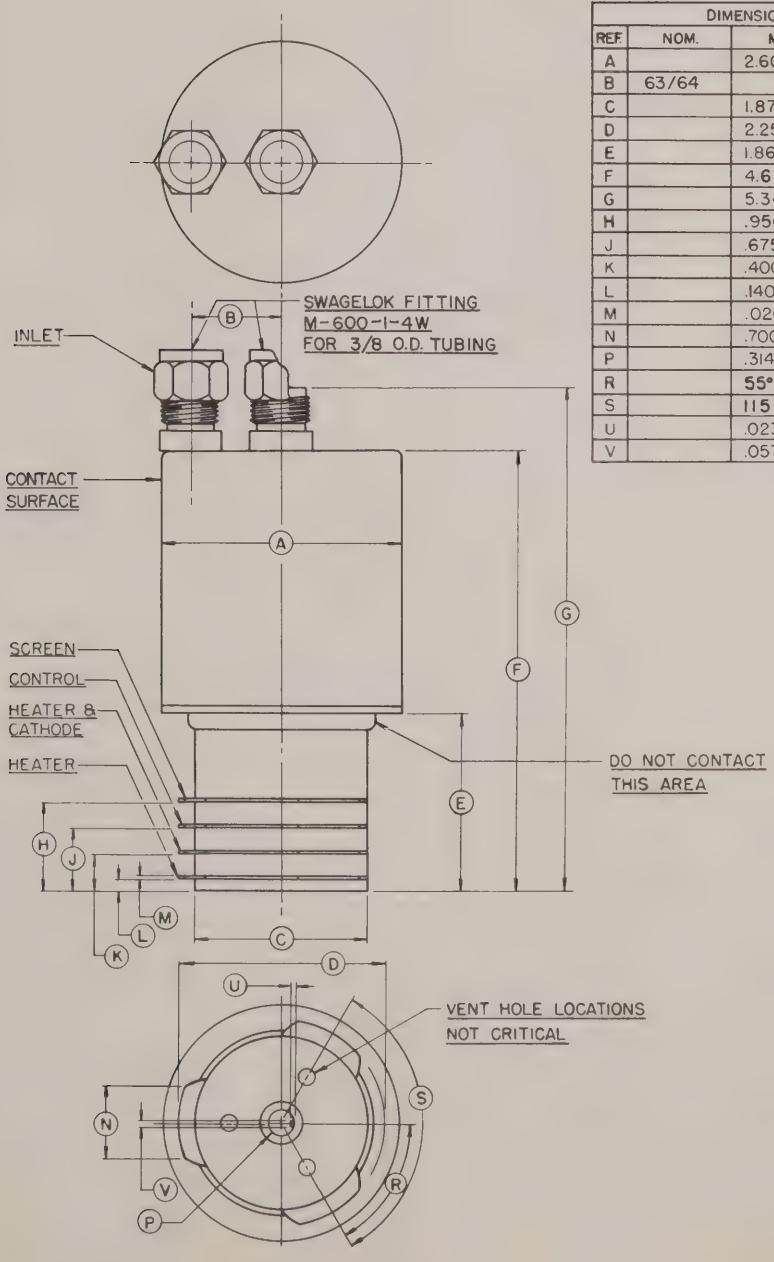
The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

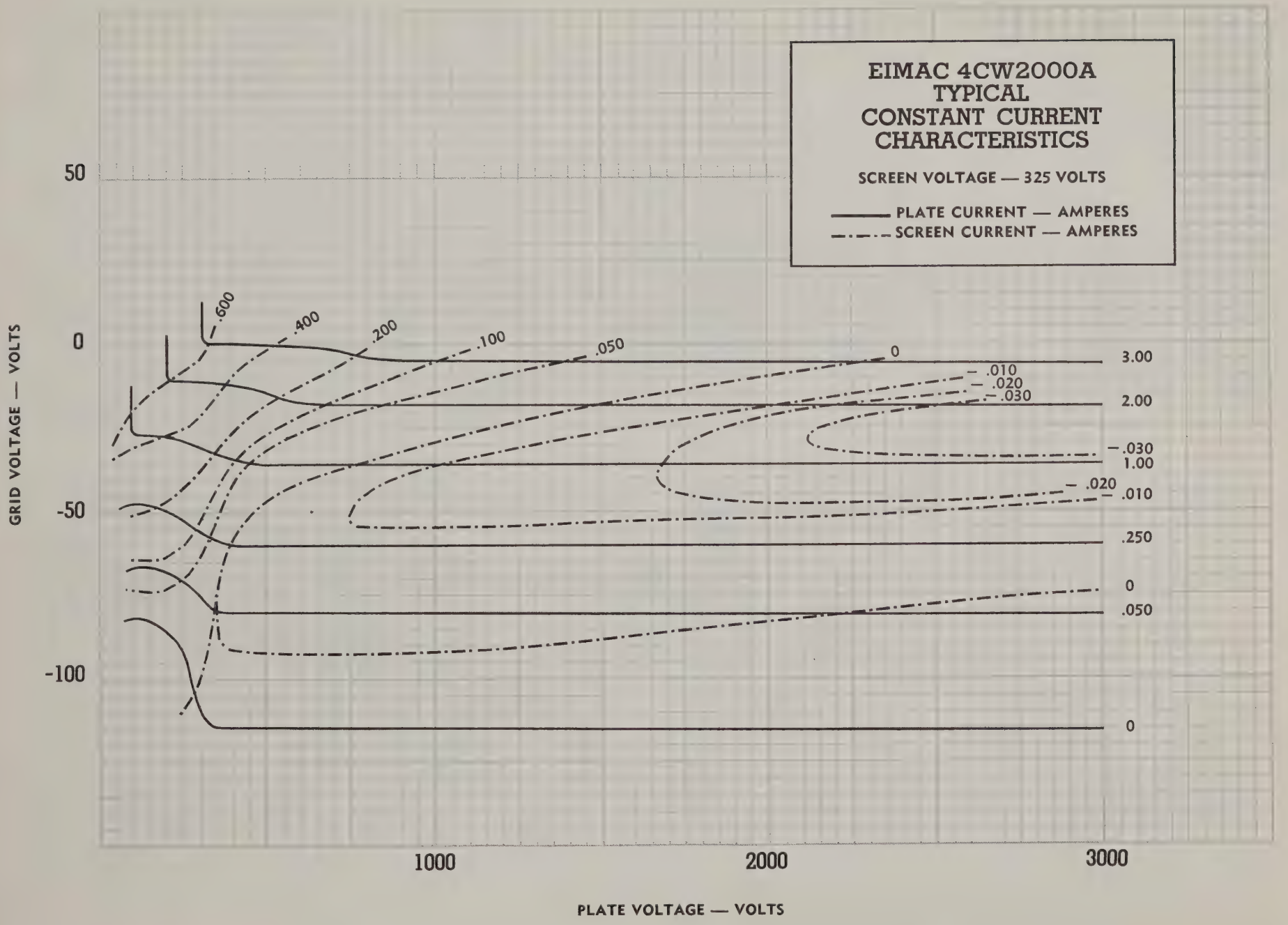
Plate Operation—The maximum rated plate dissipation power is 2000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

Voltage or Current Regulator—The 4CW2000A is attractive for regulator service. As a voltage or current regulator the DC Plate Voltage rating is increased to 6000 volts. All other ratings remain the same.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		2.609	2.663
B	63/64		
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		1.866	2.002
F		4.677	4.817
G		5.347	5.535
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
U		.023	.043
V		.057 DIA.	.073 DIA.


EIMAC 4CW2000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0
1000
2000
3000
PLATE VOLTAGE — VOLTS

4CW10,000A

RADIAL-BEAM POWER TETRODE

The Eimac 4CW10,000A is a water-cooled, ceramic-metal power tetrode which is electrically identical to the 8171/4CX10,000D (and 8170/4CX5000A, except for plate dissipation). The water-cooled anode is equipped with an integral water jacket and is rated at 12 kilowatts dissipation.

The 4CW10,000A is useful as an oscillator, amplifier or modulator at frequencies up to 110 megacycles, and is particularly suited for use as a linear rf amplifier or or class-AB audio amplifier.

A pair of these tubes operating class AB will deliver more than 30 kilowatts of audio-frequency or radio-frequency plate output power.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)		4.5		
Frequency for Maximum Ratings			30	Mc

Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	108	122	uuf
Output	18	23	uuf
Feedback		1.0	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:			
Input	48	58	uuf
Output	18	23	uuf
Feedback		0.16	uuf

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250° C
Maximum Anode-Core Temperature	250° C
Recommended Socket	Eimac SK-300A
Operating Position	Axis vertical, base up or down

Maximum Dimensions:	
Height	11.44 inches
Diameter	4.66 inches
Cooling	Water and Forced air
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

(Effective 4-15-63) © 1963 Eitel-McCullough, Inc.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	up to 30 megacycles	7500 MAX.	VOLTS
	30 to 60 megacycles	7000 MAX.	VOLTS
	60 to 110 megacycles	6500 MAX.	VOLTS
D-C SCREEN VOLTAGE		1500 MAX.	VOLTS
D-C PLATE CURRENT	up to 30 megacycles	3 MAX.	AMPERES
	30 to 60 megacycles	2.8 MAX.	AMPERES
	60 to 110 megacycles	2.6 MAX.	AMPERES
PLATE DISSIPATION		10,000 MAX.	WATTS
SCREEN DISSIPATION		250 MAX.	WATTS
GRID DISSIPATION		75 MAX.	WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	500	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.8	amperes
D-C Screen Current	0.5	ampere
D-C Grid Current	0.25	ampere
Peak R-F Grid Voltage	590	volts
Driving Power	150	watts
Plate Dissipation	5000	watts
Plate Output Power	16,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX.	VOLTS
D-C SCREEN VOLTAGE	1000 MAX.	VOLTS
D-C PLATE CURRENT	2.5 MAX.	AMPERES
PLATE DISSIPATION*	6650 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

*Corresponds to 10,000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	500	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.4	amperes
D-C Screen Current	0.4	ampere
D-C Grid Current	0.22	ampere
Peak R-F Grid Voltage	550	volts
Grid Driving Power	120	watts
Plate Dissipation	3500	watts
Plate Output Power	8.5	kilowatts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX.	VOLTS
D-C SCREEN VOLTAGE	1500 MAX.	VOLTS
D-C PLATE CURRENT	4.0 MAX.	AMPERES
PLATE DISSIPATION	12,000 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7500	volts
D-C Screen Voltage	1500	1500	1500	1500	volts
D-C Grid Voltage	—315	—320	—330	—340	volts
Max.-Signal Plate Current	6.66	6.66	6.66	6.66	ampere
Zero-Signal Plate Current*	0.50	0.50	0.50	0.50	ampere
Max.-Signal Screen Current	0.33	0.32	0.30	0.25	ampere
Zero-Signal Screen Current	0	0	0	0	ampere
Peak A-F Driving Voltage	305	310	320	330	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	940	1320	1700	2280	ohms
Max.-Signal Plate Dissipation *	6,670	7,950	8,100	9,050	watts
Max.-Signal Plate Output Power	13,300	17,500	23,800	31,900	watts

*Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX.	VOLTS
D-C SCREEN VOLTAGE	1500 MAX.	VOLTS
D-C PLATE CURRENT	4.0 MAX.	AMPERES
PLATE DISSIPATION	12,000 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions,
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1500	volts
D-C Grid Voltage*	—340	volts
Max.-Signal Plate Current	3.33	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	0.125	ampere
Peak R-F Grid Voltage	330	volts
Driving Power	0	watts
Plate Dissipation	9050	watts
Plate Output Power**	15,950	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses, either input or output, has been made.

APPLICATION

MECHANICAL

Mounting—The 4CW10,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac SK-300A air-system socket may be used with the 4CW10,000A. The socket has provision for directing cooling air through the socket and over the base seals.

Cooling—Base terminal cooling is accomplished by directing air through the socket and over the filament and grid seals. Anode cooling is accomplished by circulating water through the integral water jacket. The table below lists minimum water flow rates for proper cooling at various plate dissipation levels.

Minimum Cooling Water Requirement		
Plate Dissipation (kw)	Quantity (gpm)	Pressure Drop (psi)
6	4.0	2.2
8	5.1	3.1
10	6.3	4.3
12	7.4	5.5

Note: Since power dissipated by the filaments represented about 560 watts and grid plus screen dissipation can represent another 325 watts, an extra 900 watts has been added to plate dissipation in preparing this tabulation.

Maximum outlet-water temperature must never exceed 70°C and inlet-water pressure should be limited to 50 psi.

When the tube is mounted with its anode up, the water inlet is on the outer connector; when the anode is down, the inlet is the center connector. Water and air flow should start whenever filament voltage is applied. There is no danger in removing cooling water and air simultaneously with power removal.

Base cooling may be accomplished by directing approximately 30 cfm of air through the socket and over the seals. Pressure drop will be approximately 0.1 inch of water. An alternate method for frequencies below 30 Mc is to direct approximately 10 cfm through a ¾" ID tube directly at the center stud. The jet should be no more than two inches from the stud.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CW10,000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CW10,000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

Control Grid Operation—The 4CW10,000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CW10,000A must not exceed 250 watts.

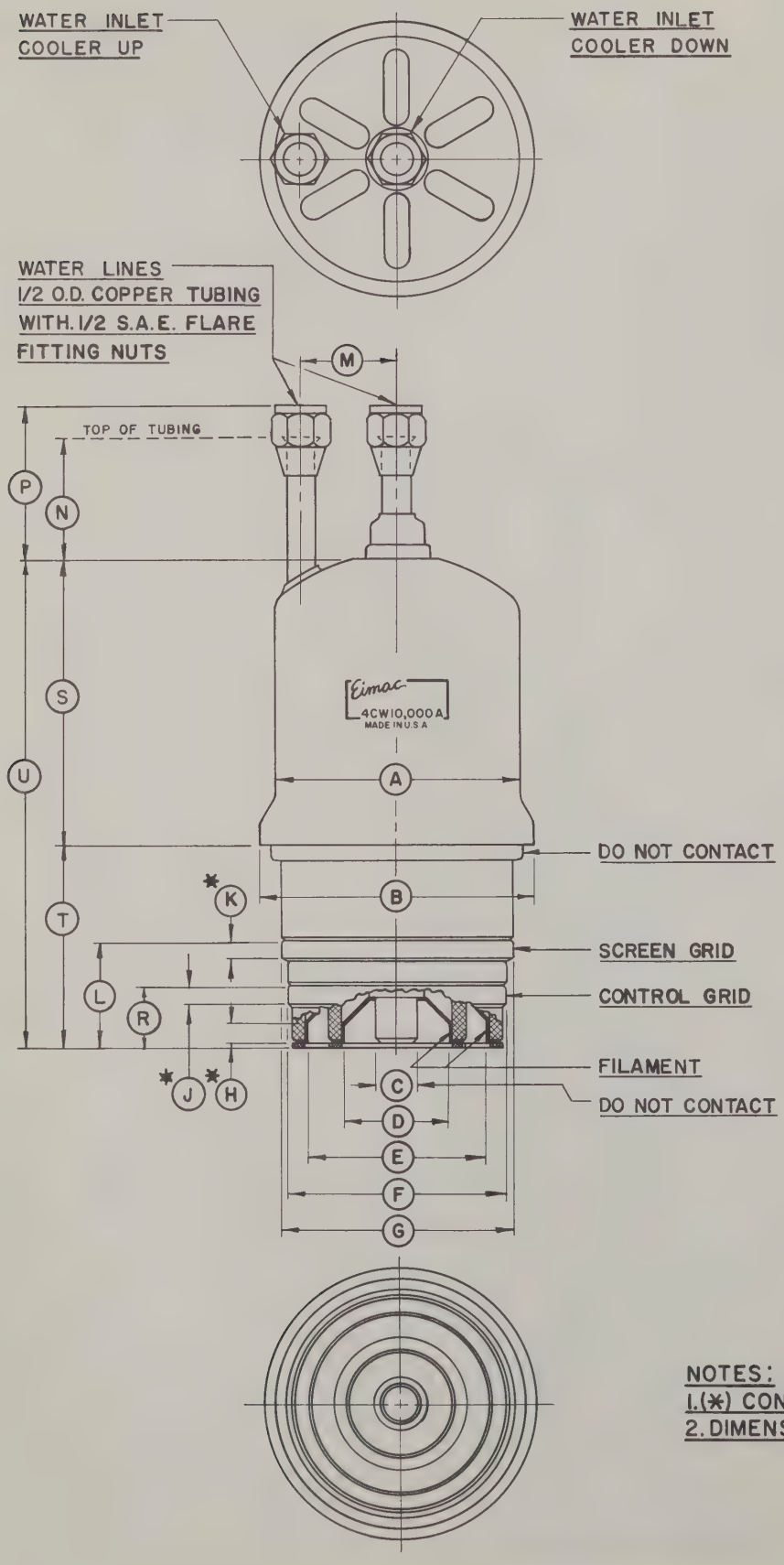
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation rating for the 4CW10,000A is 10,000 watts for most applications, but for audio and SSB amplifier applications, the maximum allowable dissipation is 12,000 watts.

When the 4CW10,000A is operated as a plate-modulated r f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 6650-watt maximum plate dissipation rating will be exceeded.

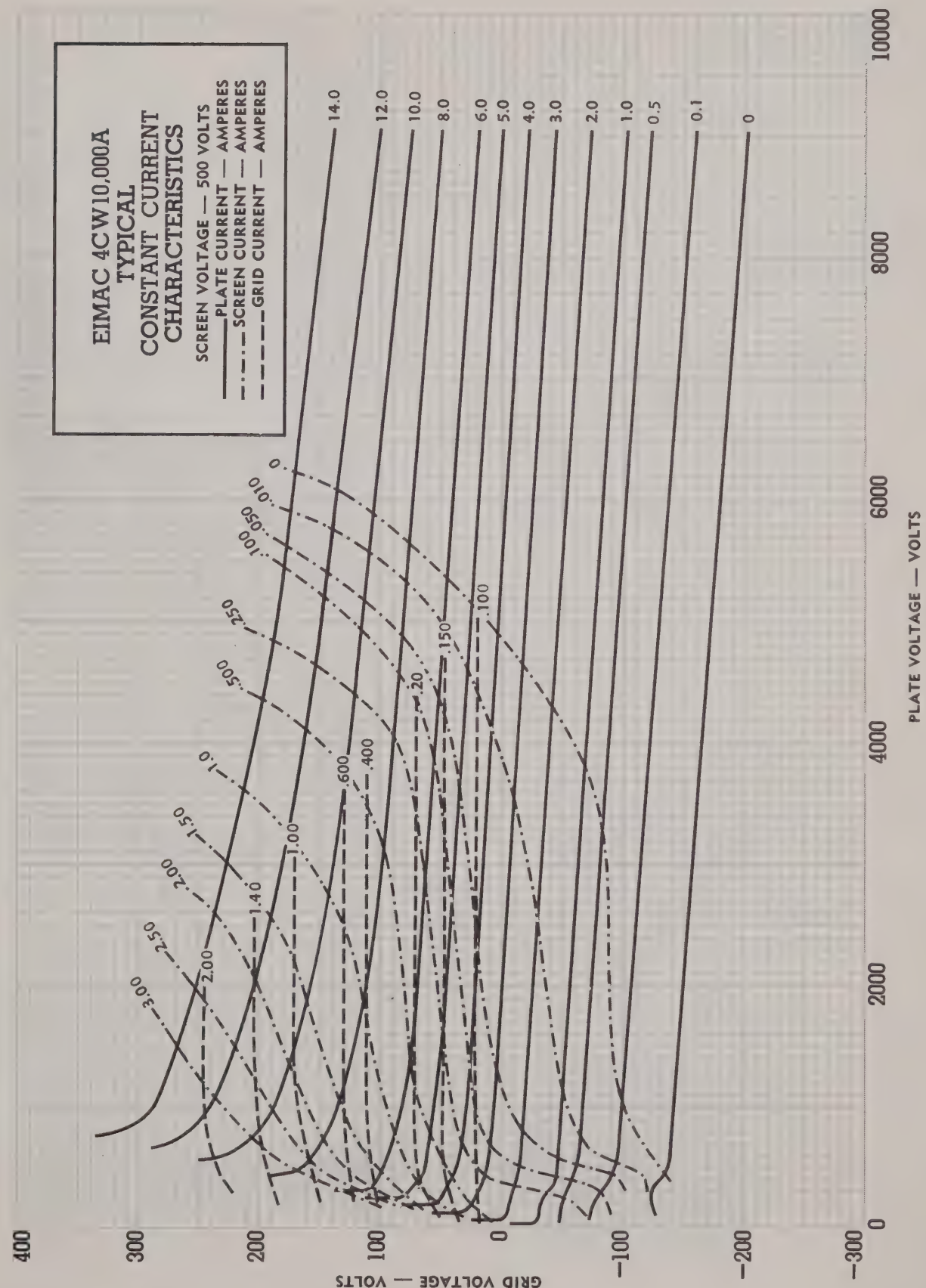
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

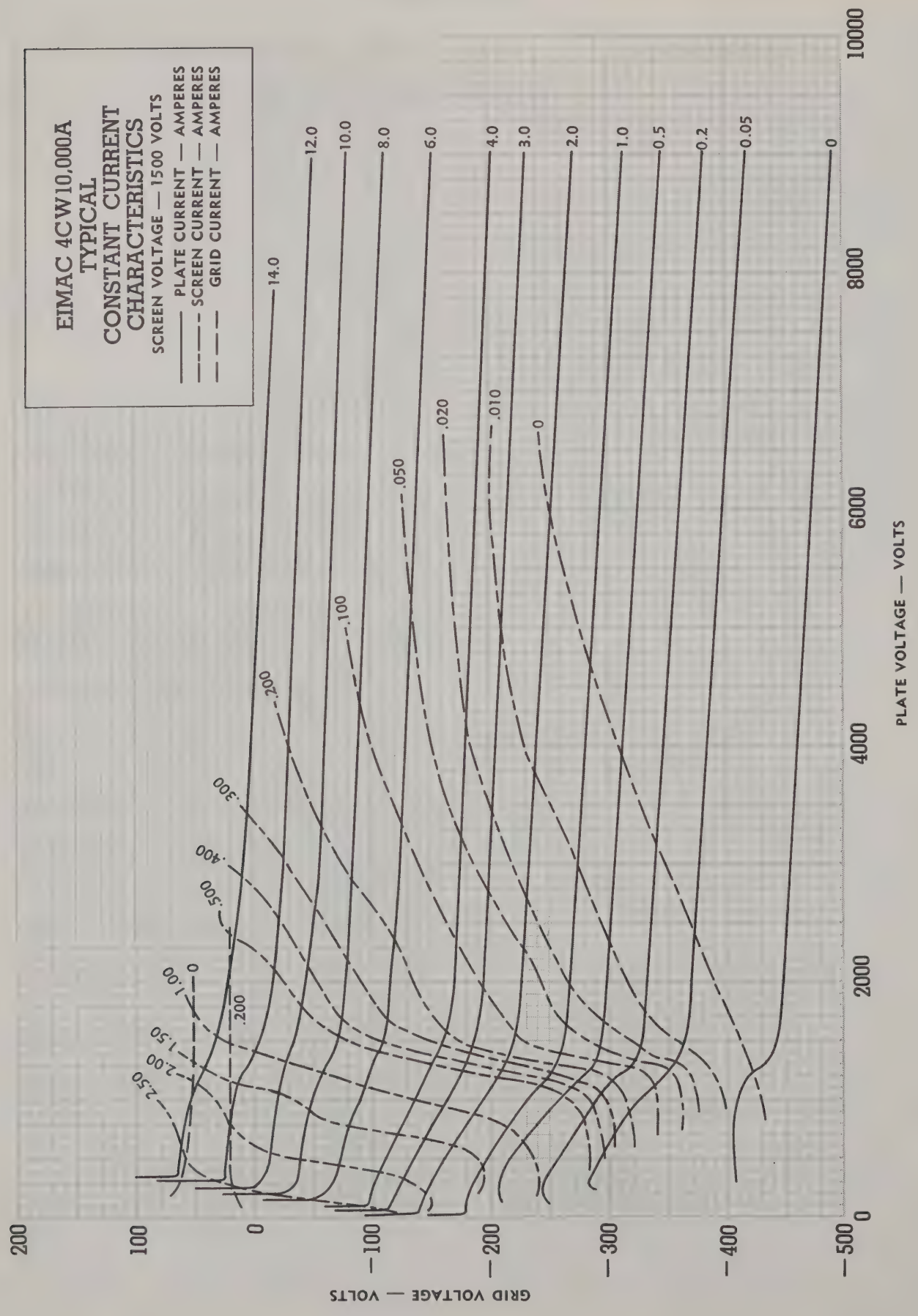


DIMENSION DATA			
REF	NOM.	MIN.	MAX.
A		4.094	4.156
B		4.594	4.656
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		1.500	1.750
N		1.937	2.187
P		2.312	2.812
R		.986	1.050
S		4.780	5.025
T		3.350	3.650
U		8.125	8.625

These dimensions reflect standard manufacturing tolerances. They should not be used as the basis for purchase specifications unless checked with Eitel-McCullough, Inc.

NOTES:
1.(*) CONTACT SURFACE,
2. DIMENSIONS IN INCHES.


EIMAC 4CW10,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14.0
12.0
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
0
.010
.050
.100
.250
.500
1.0
1.50
2.00
2.50
3.00
1.40
.600
.400
.150
.100
.20
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000


EIMAC 4CW10,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
0.5
0.2
0.05
0
.050
.020
.010
.100
.200
.300
.400
.500
1.00
1.50
2.00
2.50
200
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

Eimac®

EITEL-McCULLOUGH, INC.

TABLE OF CONTENTS

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	———
Eimac and EIA Tube Number Cross Reference Sheet	8-18-63
Power Frequency Chart for Power Grid	———
Power Frequency Chart for CW Power Klystrons	———
Power Frequency Chart for Pulse Power Klystrons	———

DIODES—RECTIFIERS—PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	7-1-52
253	7-1-52
8020(100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	3-20-62
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX10,000A1/8158	1-1-63
3CX10,000A3/8159	10-20-61
3CX10,000A7/8160	6-15-62
3W5000A1/8240	2-18-63
3W5000A3/8242	10-20-61
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61

TRIODES (Continued)	Effective Date
3X2500F3/8251	12-5-62
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	7-21-58
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50

TETRODES—PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C,F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61
4CX300A/8167	12-1-63
4CX350A/8321 & 4CX350B/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	3-18-59
4CX3000A/8169	3-1-63
4CX5000A/8170	2-15-63
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	10-10-62
4W300B	6-16-60

(Effective 12-18-63) © Copyright 1952-1963 by Eitel-McCullough, Inc. Printed in U.S.A.

*Not recommended for New Equipment Design.

TABLE OF CONTENTS

	Effective Date
4W20,000A/8173	2-1-62
4X150A & 4X150D	6-15-60
4X150G	10-21-59
4X150R/8296 & 4X150S/8297	5-15-62
4X250B	1-1-60
4X500A	3-31-61
7580	3-31-61
4E27A/5-125B	8-15-52

POWER KLYSTRONS

3K2500LX	9-15-58
3K2500SG	4-22-58
3K3000LQ	6-6-58
3K50,000LA, F, Q	5-9-58
3KM3000LA	6-6-58
3KM4000LT	11-15-62
3KM50,000PA	7-15-60
4K3CB	10-16-62
4K50,000LQ	5-28-58
4KM50SK	5-2-63
4KM100LA	9-25-62
4KM3000LQ	9-1-60
4KM3000LR	10-1-60
4KM50,000LA3	10-20-61
4KM50,000LF	10-20-61
4KM50,000LQ	8-15-60
4KM50,000LR	10-20-61
4KM170,000LA	10-1-60
4KMP10,000LF	10-1-60
5K210,000LQ	10-20-61
X626AC	10-20-61

WATER LOAD

WL-150	11-1-63

REFLEX KLYSTRONS TWT—VTM

REFLEX KLYSTRONS

1K20XD	———
1K20XD-A	12-27-62
1K20XD-S	12-29-62
1K20XK	———
1K20XN-A	12-27-62
1K20XS	———
1K015CA, CG	2-16-60
1K75CH, CK	———
1K75CS	8-10-60
1K125CB	———
X1075	8-10-62
X1075-A	8-10-62
X1115A	3-5-63
X1115B	3-5-63
X1116A	3-5-63
X1116B	3-5-63
X-1120	6-19-63
X-1120-B	6-19-63
X-1130	6-19-63

TWT

EM-778/8198	4-1-62
EM-779	4-1-62

TWT (Continued)

EM-1006	4-1-62
EM-1010	4-1-62
EM-1011	4-1-62
EM-1015	4-1-62
EM-1016	4-1-62
X1021	8-1-62
EM-1025	4-1-62
EM-1030	4-1-62
EM-1031	4-1-62
EM-1045	4-1-62
EM-1046	4-1-62
EM-1050	4-1-62
EM-1051	4-1-62
EM-1060	4-1-62

VTM

EM-747	2-15-63
EM-1080	6-14-63
X1081	2-15-63
X1084	8-1-62
X1085	7-27-62
EM1086	10-27-62
X1091	10-27-62
X1092	3-5-63

OTHER PRODUCTS

HV-1 Diffusion Pump	11-1-60
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
SK-300	1-1-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	5-21-63
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK620A	1-15-63
SK-630, SK630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800A, SK-806	9-15-60
SK-810, SK-806	9-15-60
SK-890, SK-806	9-15-60
SK-900, SK-906	6-1-60
SK-1300	5-9-63

CAVITY AMPLIFIER

X4523	3-5-63
X4524	3-5-63
X4539	3-5-63
X4540	3-5-63
X4546	9-1-63

Eimac

EITEL-McCULLOUGH, INC.

January, 1964

EIMAC and EIA TUBE NUMBER CROSS REFERENCE SHEET

EIMAC NO.	EIA NO.
3CPN10A5	7815
3CPX100A5	7815R
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8238
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3W5000A1	8240
3W5000A3	8242
3W5000F1	8241
3W5000F3	8243
3X2500A3	8161
3X2500F3	8251
3X3000A1	8238
3X3000F1	8239
3X3000F7	8162
3–400Z	8163
3–1000Z	8164
4–65A	8165
4–400A	8348
4–1000A	8166
4CV100,000C	8351
4CW50,000C	8350
4CX250B	7203
4CX250F	7204
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX350A	8321
4CX350F	8322
4CX1000A	8168
4CX3000A	8169
4CX5000A	8170
4CX10,000D	8171
4CX15,000A	8281
4CX35,000C	8349
4PR60B	8252
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X150R	8296
4X150S	8297

EIA NO.	EIMAC NO.
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7289	3CX100A5
7580W	4CX250R
7815	3CPN10A5
7815R	3CPX100A5
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3X2500A3
8162	3X3000F7
8163	3–400Z
8164	3–1000Z
8165	4–65A
8166	4–1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3X3000A1
8239	3X3000F1
8240	3W5000A1
8241	3W5000F1
8242	3W5000A3
8243	3W5000F3
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3X2500F3
8252	4PR60B
8281	4CX15,000A
8283	3CX1000A7
8296	4X150R
8297	4X150S
8321	4CX350A
8322	4CX350F
8348	4–400A
8349	4CX35,000C
8350	4CW50,000C
8351	4CV100,000C

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

8248
4PR250C

RADIAL-BEAM PULSE TETRODE MODULATOR OSCILLATOR AMPLIFIER

The Eimac 8248/4PR250C is a pulse tetrode intended for use in pulse-modulator, switch tube, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a tantalum plate and non-emitting grids, is recommended for use in new equipments where voltages to 50 kilovolts are required.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-410 Air-System Socket.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		5.0		volts
Current	13.5		14.7	amperes
Amplification Factor (Grid to Screen)		5.2		
Direct Interelectrode Capacitances, Grounded Cathode:*				
Grid-Plate		0.15		uuf
Input	11		15	uuf
Output	2.5		4.0	uuf

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-410 Air-System Socket
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions	
Length	7.63 inches
Diameter	3.6 inches
Net Weight (tube only)	12.5 ounces

*In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	50 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK PLATE CURRENT*	4.0 MAX. AMPERES
PLATE DISSIPATION (AVG.)	250 MAX. WATTS
SCREEN DISSIPATION (AVG.)	25 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

*Note: In switch tube applications with capacitive loads, plate current may be increased to 5.5 amperes.

TYPICAL OPERATION

DC Plate Voltage	30	40	50 kV
DC Screen Voltage	1.5	1.5	1.5 kV
D-C Grid Voltage	-600	-650	-700 volts
Pulse Plate Voltage	28	38	48 kilovolts
Peak Pulse Current	4.0	4.0	4.0 amps
Pulse Screen Current	0.5	0.5	0.5 amp
Pulse Grid Current	0.03	0.03	0.03 amps
Pulse Pos. Grid Voltage	130	130	130 volts
Pulse Drive Power	25	25	25 watts
Pulse Plate Input Power	120	160	200 kW
Pulse Plate Output Power	112	152	192 kW
Duty	3	3	3 percent

(Effective 12-1-63 © Copyright 1963 by Eitel-McCullough, Inc.

RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS

PEAK DC PLATE VOLTAGE	35 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	5.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	250 MAX. WATTS
SCREEN DISSIPATION (AVG.)	25 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

*When used as a RF Plate-and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid over-heating this element during the inter-pulse periods.

TYPICAL OPERATION

Pulse Plate Voltage	25	30	35 kV
Pulse Screen Voltage	1.5	1.5	1.5 kV
DC Grid Voltage	–650	–675	–700 volts
Pulse Plate Current**	940	925	900 mA
Pulse Screen Current	30	30	30 mA
Pulse Grid Current	6	6	6 mA
Peak RF Grid Voltage	780	805	830 volts
Pulse Drive Power	4.7	5	4.5 watts
Pulse Plate Input Power	23.5	27.7	31.5 kW
Pulse Plate Output Power	19.0	23.0	26.5 kW
Duty	5.5	5	5 percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	25 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	5.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	250 MAX. WATTS
SCREEN DISSIPATION (AVG.)	25 MAX. WATTS
GRID DISSIPATION (AVG.)	10 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	20	25	kV
DC Screen Voltage	1.5	1.5	kV
DC Grid Voltage	–600	–650	volts
Pulse Plate Current**	940	940	mA
Pulse Screen Current	30	30	mA
Pulse Grid Current	6	6	mA
Peak RF Grid Voltage	730	780	volts
Pulse Drive Power	4.4	4.7	watts
Pulse Plate Input Power	18.8	23.5	kW
Pulse Plate Output Power	15.0	19.0	kW
Duty	6	5.5	percent

** The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting—The 4PR250C must be operated vertically base up or down. The SK-410 Air-System Socket may be used to aid in directing air to the metal base shell.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers. The tube must be protected from severe shock and vibration.

Cooling—Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200°C. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-8 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR250C is operated at dc or low frequencies in an Eimac SK-410 Air System Socket, the minimum airflow requirements to maintain seal temperatures at 200°C in 25°C inlet air are approximately 2 to 5 cfm.

When the Eimac 4PR250C is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR250C is used in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 4PR250C should not be allowed to exceed 250 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

The average power dissipated by the screen-grid and the control-grid must not exceed 25 watts and 5 watts, respectively.

Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 4PR250C are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

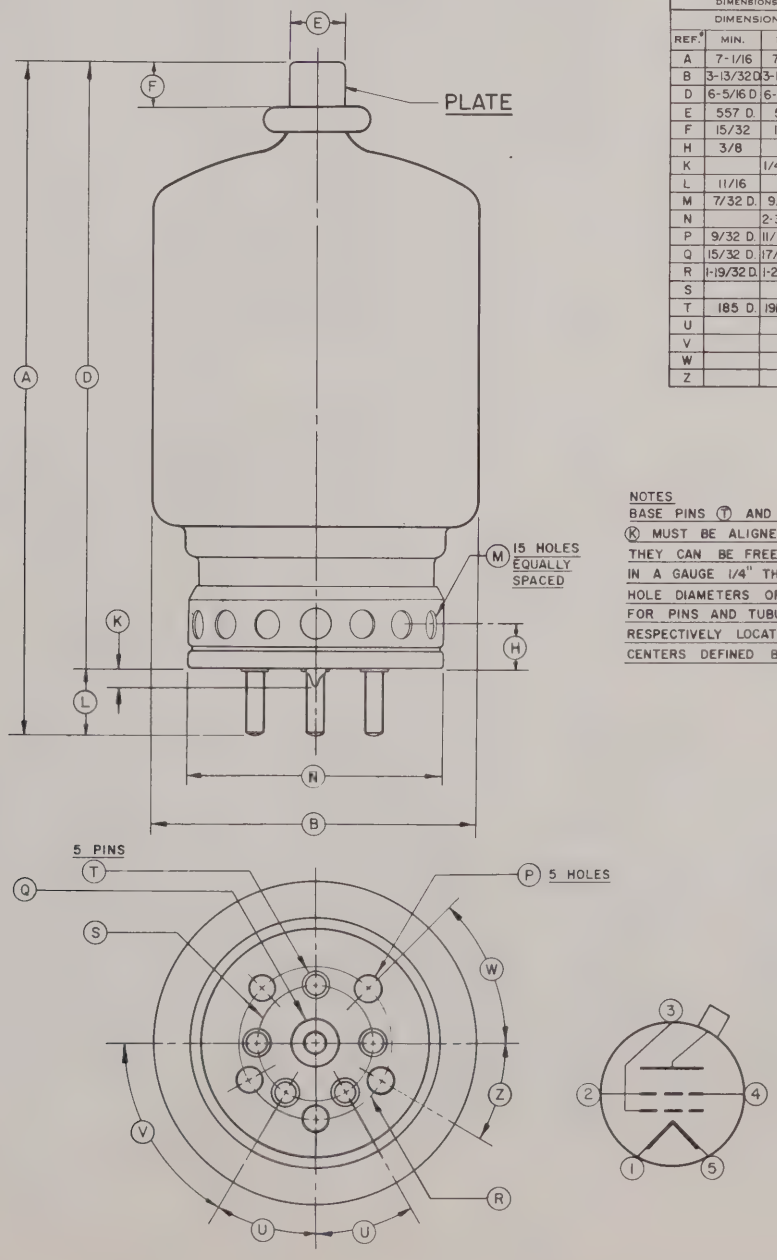
Each 4PR250C is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 50 KV, a screen voltage of 1.5 KV, with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 675 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between -500 volts and -650 volts.

Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate wave form is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

As a switch tube with capacitive loading, as in a floating deck modulator, the peak plate current during the pulse may reach 5.5 amperes. This can be tolerated since under capacitive load conditions the plate voltage at the beginning of the pulse is equal to applied dc voltage, with high plate current and low screen grid current. As the load is charged, plate current falls while screen current rises. Protection for the screen must be provided to limit dissipation at the end of the pulse.

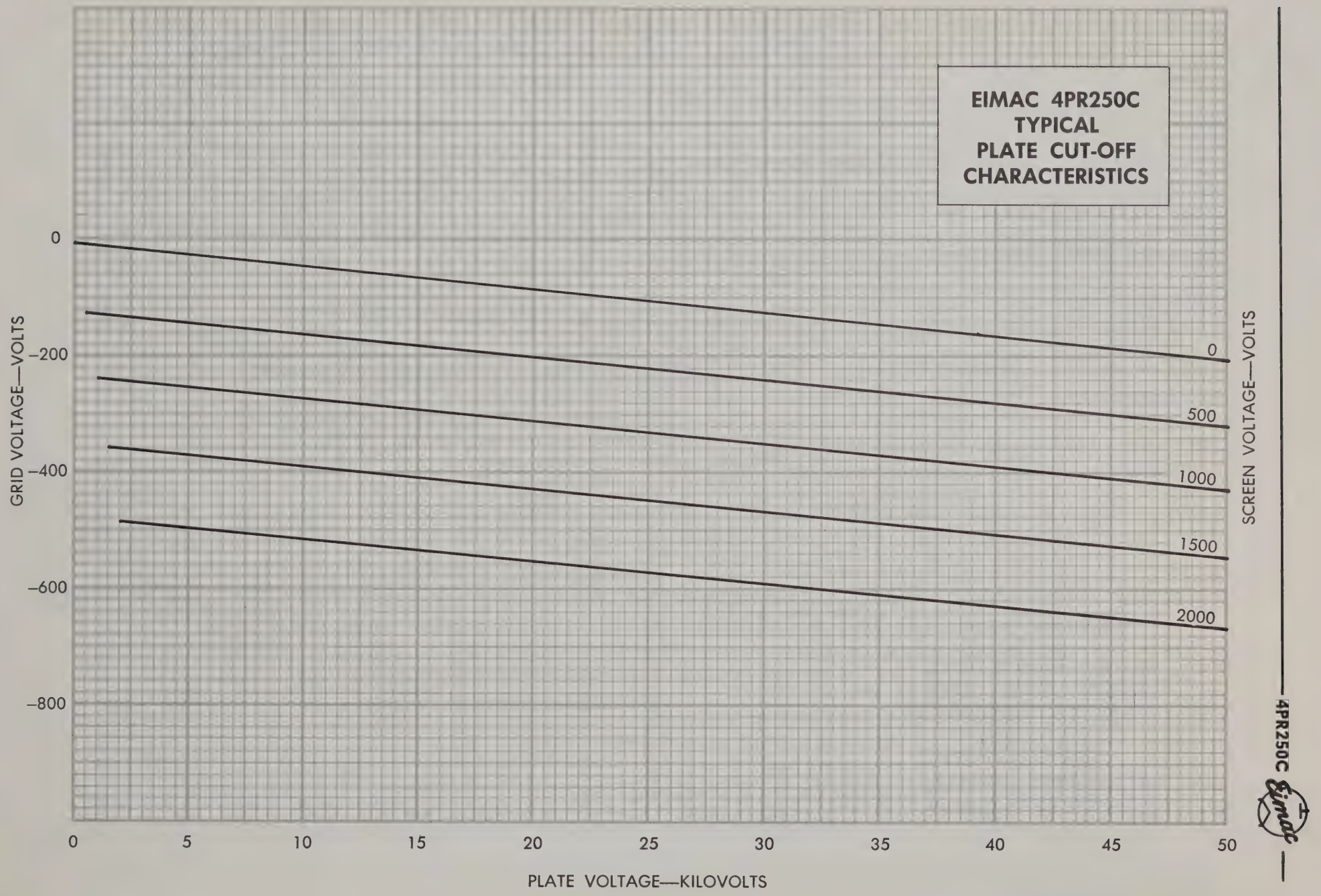
X-Ray Precautions—As with any tube operating at these high voltages and currents, x-rays will be generated in dangerous quantities. Adequate shielding must be provided in any equipment to protect personnel protection.

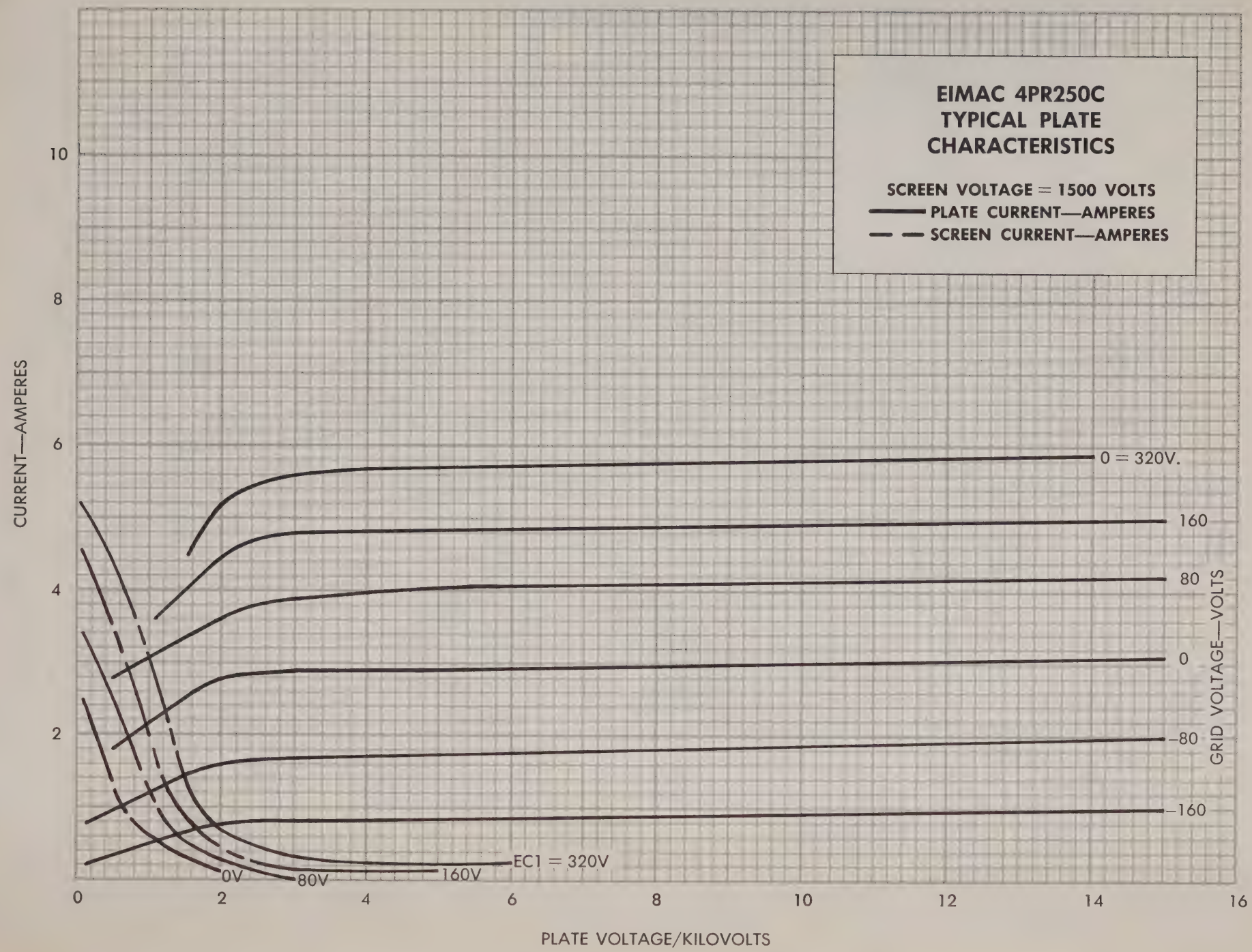
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

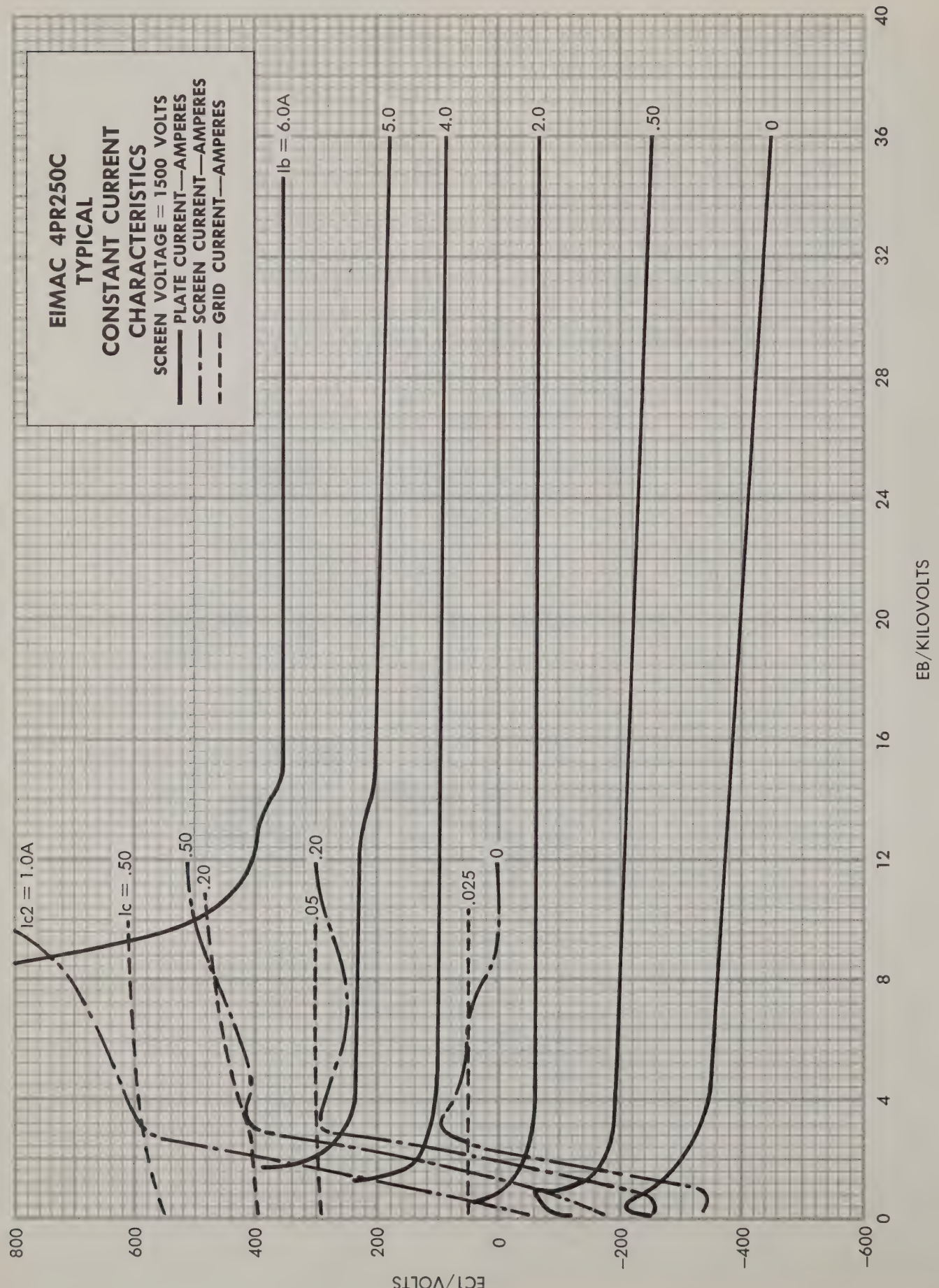


DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX	NOM.
A	7-1/16	7-5/8	
B	3-13/32 D.	3-19/32 D.	
D	6-5/16 D.	6-13/16 D.	
E	.557 D.	.567 D.	
F	15/32	17/32	
H	3/8	1/2	
K		1/4 NOTE 1	
L	11/16	7/8	
M	7/32 D.	9/32 D.	
N		2-3/4 D.	
P	9/32 D.	11/32 D.	
Q	15/32 D.	17/32 D.	
R	1-19/32 D.	1-21/32 D.	
S			1-1/4 D. NOTE 1
T	.185 D.	.191 D. NOTE 1	
U			30° NOTE 1
V			60° NOTE 1
W			45°
Z			30°

NOTES
BASE PINS (T) AND TUBULATION (K) MUST BE ALIGNED SO THAT THEY CAN BE FREELY INSERTED IN A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 FOR PINS AND TUBULATION RESPECTIVELY LOCATED ON TRUE CENTERS DEFINED BY (S) (U) (V).


EIMAC 4PR250C
TYPICAL
PLATE CUT-OFF
CHARACTERISTICS
GRID VOLTAGE—VOLTS
0
–200
–400
–600
–800
0
5
10
15
20
25
30
35
40
45
50
PLATE VOLTAGE—KILOVOLTS
SCREEN VOLTAGE—VOLTS
0
500
1000
1500
2000


EIMAC 4PR250C
TYPICAL PLATE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
CURRENT—AMPERES
10
8
6
4
2
0
2
4
6
8
10
12
14
16
PLATE VOLTAGE/KILOVOLTS
0 = 320V.
160
80
0
–80
–160
GRID VOLTAGE—VOLTS
EC1 = 320V
0V
80V
160V


EIMAC 4PR250C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
Ib = 6.0A
5.0
4.0
2.0
.50
0
Ic2 = 1.0A
Ic = .50
.50
.20
.05
.20
.025
0
EC1/VOLTS
800
600
400
200
0
−200
−400
−600
0
4
8
12
16
20
24
28
32
36
40
EB/KILOVOLTS

8160
3CX10,000A7

HIGH-MU POWER TRIODE

The Eimac 8160/3CX10,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8160/3CX10,000A7.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage	-	7.5		volts
Current	94		104	amperes
▶ Amplification Factor	-	200		

Direct Interelectrode Capacitances:	Min.	Nom.	Max.
Grid-Filament	-	-	62.0 uuf
Grid-Plate	50.0	-	40.0 uuf
Plate-Filament	32.0	-	0.3 uuf
Frequency for Maximum Ratings	-	-	160 Mc.

MECHANICAL

Base	Coaxial
Recommended Socket	Eimac SK-1300
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250° C
Ceramic-to-Metal Seals	250° C
Maximum Dimensions:	
Height	8.75 inches
Diameter	7.05 inches
Net Weight	12 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER GROUNDED-GRID, CLASS B

MAXIMUM RATINGS	
DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	12 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Values

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000 volts
Zero-Sig DC Plate Current*	0.60	0.60 amp
Max-Sig DC Plate Current	3.72	5.00 amps
Max-Sig DC Grid Current	0.71	1.00 amp
Driving Impedance	35	32 ohms
Resonant Load Impedance	1020	745 ohms
Max-Sig Driving Power	885	1540 watts
Peak Envelope Plate Output Power	17,700	24,200 watts
Power Gain	20.0	15.7 times

▶ Indicates change from sheet dated 6-15-62.

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR CLASS B, GRID DRIVEN

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	12 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Value

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000 volts
DC Grid Voltage	0	0 volts
Zero-Sig DC Plate Current*	1.20	1.20 amps
Max-Sig DC Plate Current	7.50	10.0 amps
Max-Sig DC Grid Current	1.50	2.06 amps
Driving Power	315	560 watts
Peak AF Driving Voltage (Per Tube)	250	310 volts
Load Resistance, Plate-to-Plate	2000	1520 ohms
Max-Sig Plate Output Power	35,600	47,700 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

CARRIER CONDITIONS, GROUNDED-GRID

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	12 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Value
**Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000 volts
DC Grid Voltage	0 volts
Zero-Sig DC Plate Current*	0.60 amp
DC Plate Current	2.40 amps
DC Grid Current	0.25 amp
Driving Impedance**	32 ohms
Peak Driving Voltage**	310 volts
Driving Power	330 watts
Plate Output Power	5650 watts

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR, CLASS C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	10 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	7000 volts
DC Plate Current	4.0 amps
DC Grid Voltage	-230 volts
DC Grid Current	775 mA
Peak RF Grid Voltage	555 volts
Grid Driving Power	430 watts
Plate Output Power	21.3 kW

PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 MAX. VOLTS
DC PLATE CURRENT	3.0 MAX. AMPS
PLATE DISSIPATION	6.5 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5000 volts
DC Plate Current	3.0 amps
DC Grid Voltage	-200 volts
DC Grid Current	775 mA
Peak RF Grid Voltage	490 volts
Grid Driving Power	380 watts
Plate Output Power	11.9 kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses, either input or output, has been made.

APPLICATION

Mounting— The 3CX10,000A7 must be operated vertically base up or base down. The tube must be protected from severe vibration and shock.

Cooling— The maximum temperature rating for the external surfaces of the 3CX10,000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

	Sea Level		10,000 Feet	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	85	0.18	125	0.25
6000	145	0.38	210	0.55
8000	215	0.68	315	0.99
10,000	295	1.08	430	1.60
12,000	390	1.62	565	2.35

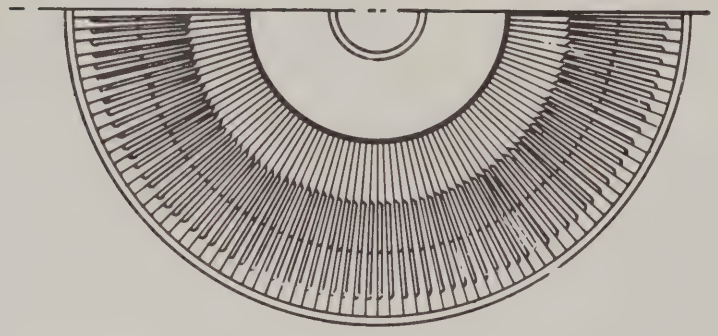
**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1250 watts dissipation.

Input Circuit— When the 3CX10,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

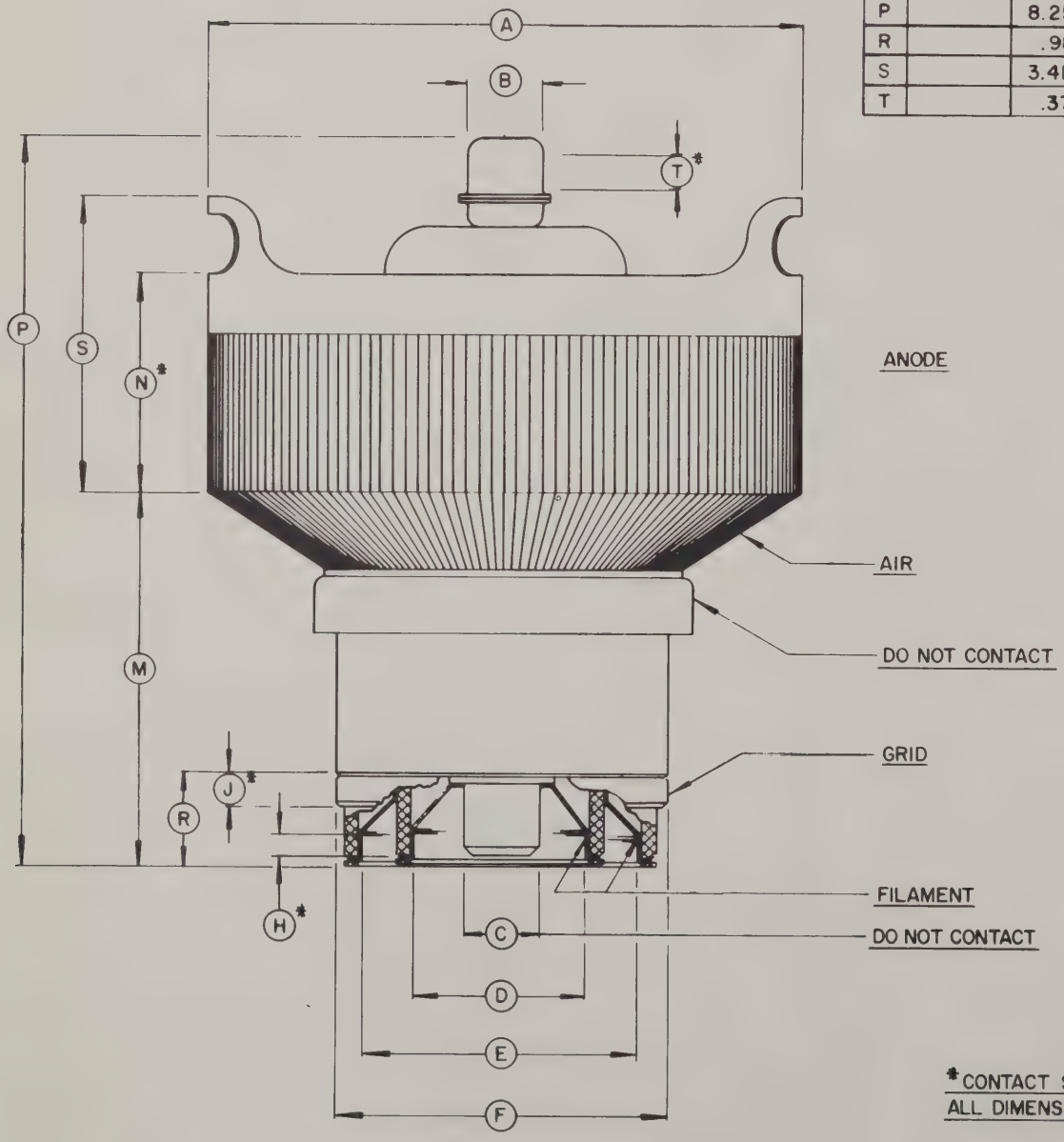
Class-C Operation— Although specifically designed for class-B service, the 3CX10,000A7 may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3CX10,000A7 can be used to advantage in class-C amplifiers by employing only grid-leak bias. If driving power fails plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

Filament Operation— The rated filament voltage for the 3CX10,000A7 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

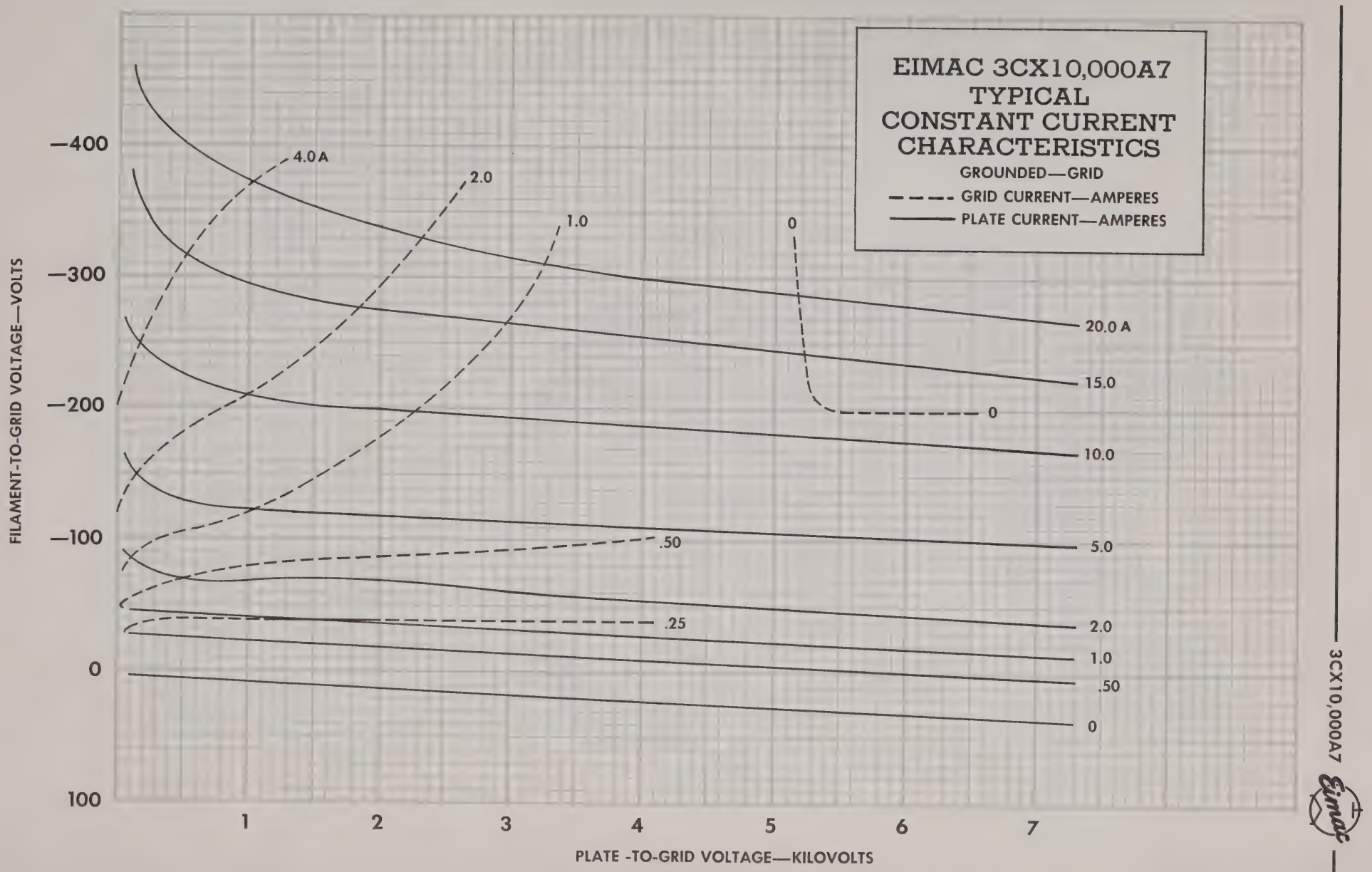
Special Applications— If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

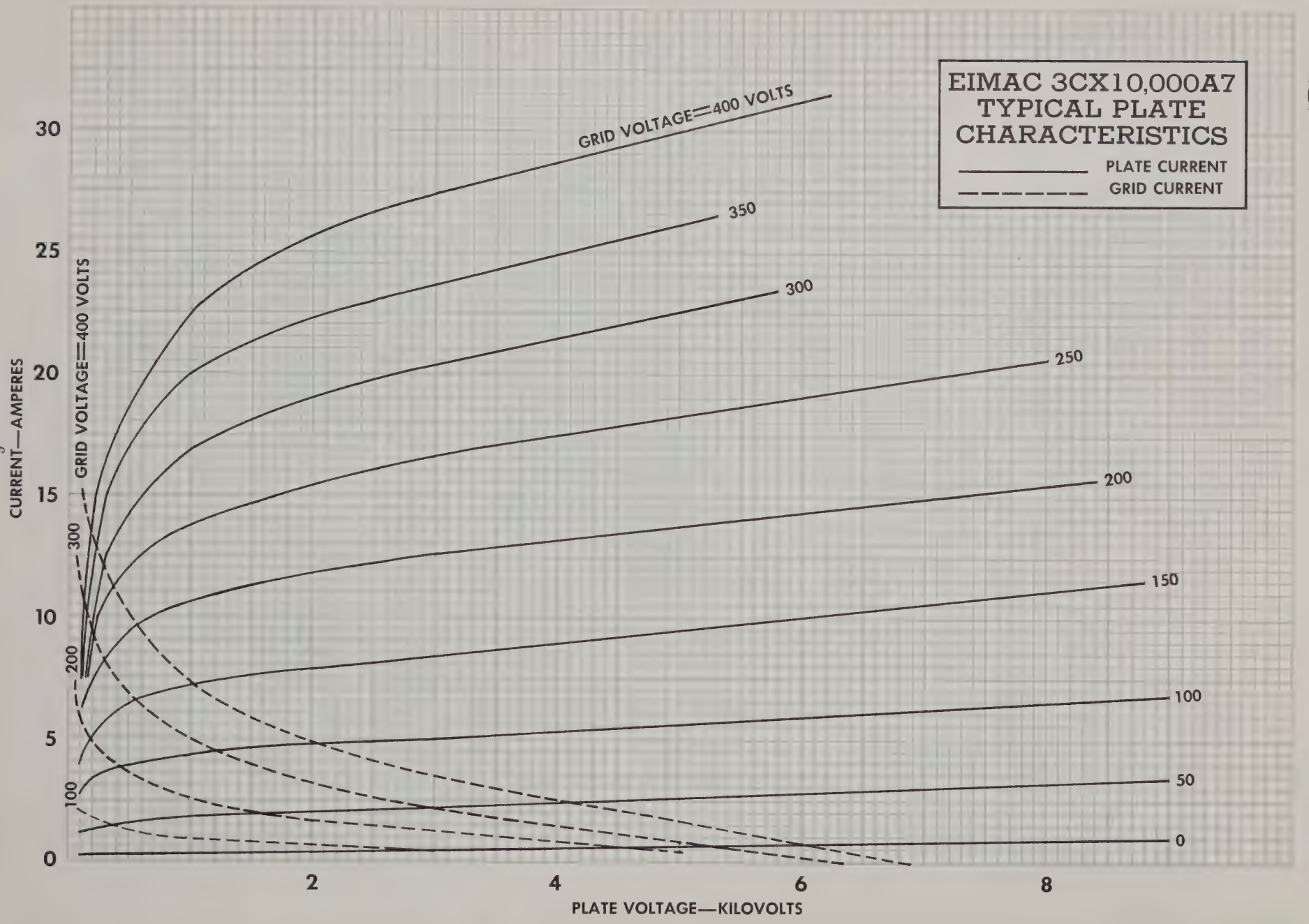


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
FILAMENT-TO-GRID VOLTAGE—VOLTS
−400
−300
−200
−100
0
100
4.0 A
2.0
1.0
0
20.0 A
15.0
0
10.0
5.0
.50
.25
2.0
1.0
.50
0
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE—KILOVOLTS


EIMAC 3CX10,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE=400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE=400 VOLTS
300
200
100
CURRENT—AMPERES
PLATE VOLTAGE—KILOVOLTS
0
5
10
15
20
25
30
2
4
6
8

8349
4CX35,000C

RADIAL BEAM POWER TETRODE



The Eimac 8349/4CX35,000C is a ceramic-metal, forced-air cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The 8349/4CX35,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The forced air cooled anode is rated at 35 kilowatts of plate dissipation.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament:	Thoriated Tungsten	
	Voltage	10 volts
	Current	300 amps
	Amplification Factor (Grid-Screen) (average)	4.5
Direct Interelectrode Capacitances, Grounded Cathode:		
	Input	465 uuf
	Output	55 uuf
	Feedback	2.4 uuf
Frequency for Maximum Ratings		30 Mc

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250° C
Maximum Anode Core Temperature	250° C
Recommended Socket	Eimac, SK-1500
Operating Position	Vertical, base up or down
Maximum Dimensions:	
Height	17.0 inches
Diameter	9.75 inches
Cooling	Forced air
Net Weight	50 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	750	750	750	volts
DC Grid Voltage	-425	-480	-545	volts
DC Plate Current	6.70	6.45	6.35	amps
DC Screen Current	.925	.810	.895	amp
DC Grid Current	.320	.355	.335	amp
Peak RF Grid Voltage	575	640	695	volts
Driving Power	185	225	230	watts
Plate Dissipation	12.0	14.0	17.0	kW
Plate Output Power	55.0	82.5	110.0	kW

Note: Maximum plate voltage and plate current cannot be applied simultaneously without exceeding dissipation ratings.

(Effective 11-1-63) © Copyright 1963 by Eitel-McCullough, Inc.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

▶ MAXIMUM RATINGS

DC PLATE VOLTAGE	17,500 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION*	23,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

* Corresponds to 35,000 watts at 100 percent sine-wave modulation

**Approximate value

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	7.5	10	15	kV
DC Screen Voltage	750	750	750	volts
Peak AF Screen Voltage (For 100% modulation)**	640	675	630	volts
DC Grid Voltage	-460	-520	-540	volts
DC Plate Current	7.0	6.6	6.45	amps
DC Screen Current	1.2	.985	.890	amp
DC Grid Current	.375	.370	.355	amp
Peak RF Grid Voltage	630	680	700	volts
Grid Driving Power	235	250	250	watts
Plate Dissipation	10.5	11	14.5	kW
Plate Output Power	42.0	55.0	82.5	kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

* Per Tube

**Approximate value

▶ TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	-290	-340	-370	volts
Max-Signal Plate Current	17.4	15.1	14.5	amps
Zero-Signal Plate Current	4.0	2.0	2.0	amps
Max-Signal Screen Current**	.770	.620	.420	amp
Zero-Signal Screen Current	0	0	0	amp
Peak AF Driving Voltage*	270	310	330	volts
Driving Power	0	0	0	watts
Load Resistance, Plate-to-Plate	1150	2560	3140	ohms
Max-Signal Plate Dissipation*	33	30.5	34	kW
Max-Signal Plate Output Power	110	165	210	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Approximate value

▶ TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	-290	-340	-370	volts
Max-Signal Plate Current	8.7	7.55	7.2	amps
Zero-Signal Plate Current	2.0	1.0	1.0	amp
Max-Signal Screen Current*	.385	.310	.240	amp
Peak RF Grid Voltage	270	310	330	volts
Driving Power	0	0	0	watts
Plate Dissipation	33	30.5	34	kW
Plate Output Power	55	82.5	105	kW
Resonant Load Impedance	575	1280	1570	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

▶ Indicates change from sheet dated 10-10-62.

APPLICATION

MECHANICAL

Mounting—The 4CX35,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

▶ **Socket**—The Eimac Socket, Type SK-1500, has been designed especially for the concentric base terminals of the 4CX35,000C. The SK-1500 is not an Air System Socket. Separate base cooling is required and is accomplished by directing 60-100 CFM of air horizontally through the socket from the sides. This is most effective when directed from two diametrically opposed nozzles. A separate source of air—approximately 2 CFM must be directed into the center of the base assembly through the center hole on the SK-1500 socket.

▶ **Cooling**—The maximum temperature rating for the external surfaces of the 4CX35,000C is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 40° ambient air tabulated below (for operation below 30 megacycles). These data are for air flowing in the base-to-anode direction.

BASE-TO-ANODE AIR-FLOW		
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)
15,000	485	1.65
20,000	710	2.85
25,000	1000	5.1
30,000	1320	8.9
35,000	1650	14.5

*Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

Where equipment design calls for anode-to-base airflow, these conditions do not apply. For further information on this cooling method contact Eitel-McCullough.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX35,000C is 10.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Control-Grid Operation—The 4CX35,000C control grid has a maximum dissipation rating of 500 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation—The power dissipated by the screen of the 4CX35,000C must not exceed 1750 watts.

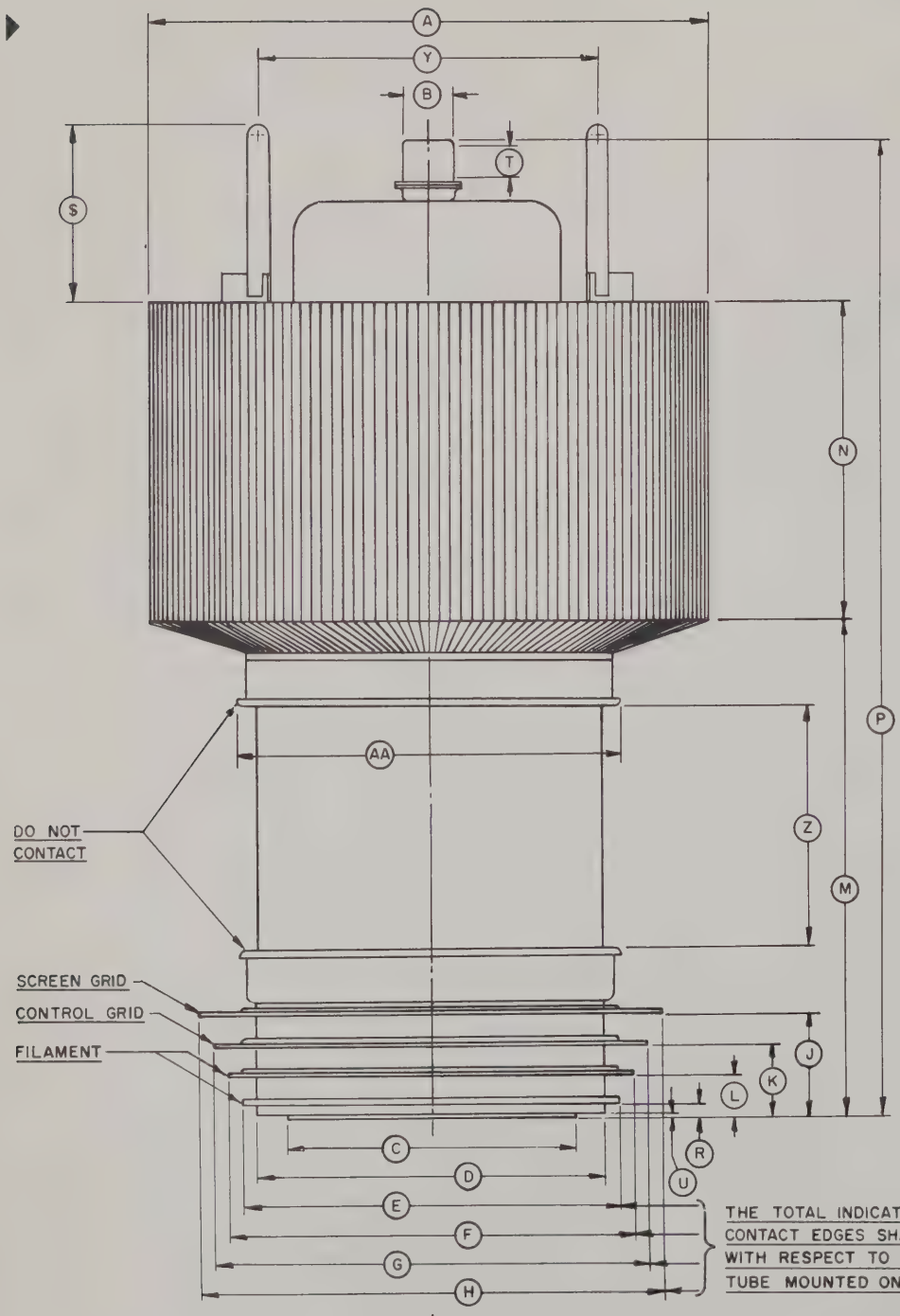
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

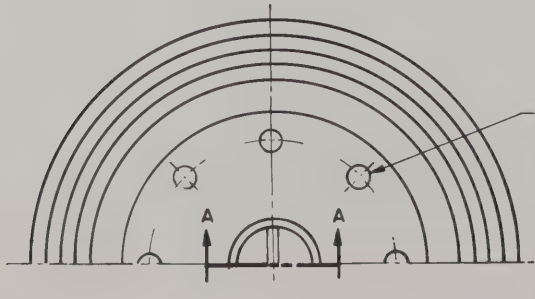
Plate Dissipation—The plate-dissipation rating for the 4CX35,000C is 35,000 watts. When the 4CX35,000C is operated as a plate-modulated rf amplifier, the plate dissipation rating is reduced to 23,000 watts. In addition the plate voltage rating is reduced to 17,500 volts. Since the power input is limited by conditions other than plate efficiency, there is little possibility of exceeding the 23,000 watt dissipation rating except during tuning.

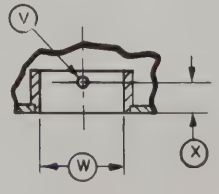
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.

▶ Indicates change from sheet dated 10-10-62.



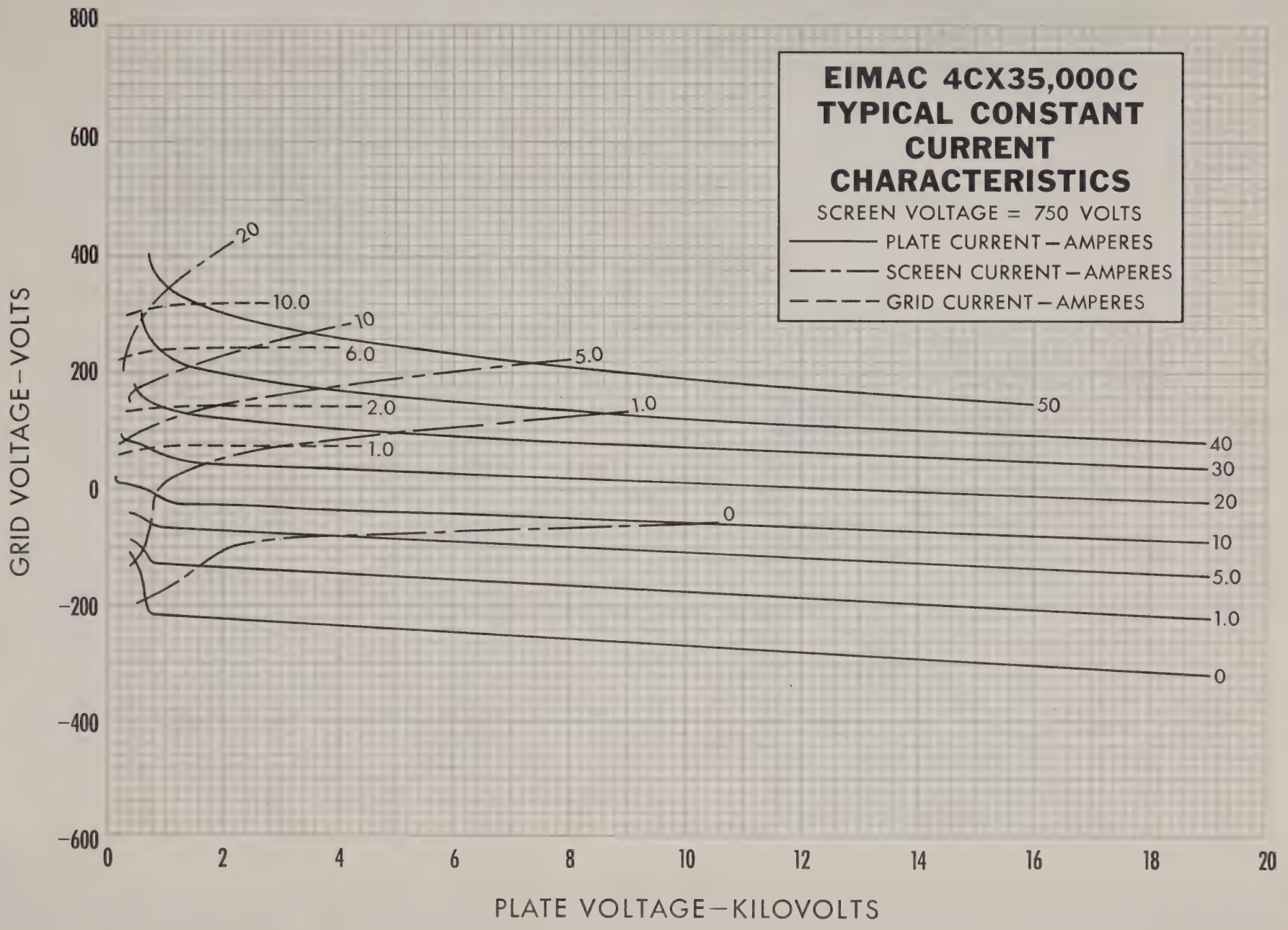
DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	9.500	9.750	
B	.860	.890	
C	4.980	5.020	
D	5.980	6.020	
E	6.510	6.560	
F	6.980	7.020	
G	7.480	7.520	
H	7.975	8.015	
J	1.750	1.800	
K	1.220	1.270	
L	.690	.740	
M	8.442	8.692	
N	5.375	5.625	
P	16.730	16.980	
R	.188	.228	
S			3.062
T	.485	.515	
U	.045	.075	
V		.135	
W	1.250	1.270	
X	.490	.530	
Y			5.875
Z	4.000		
AA			6.665

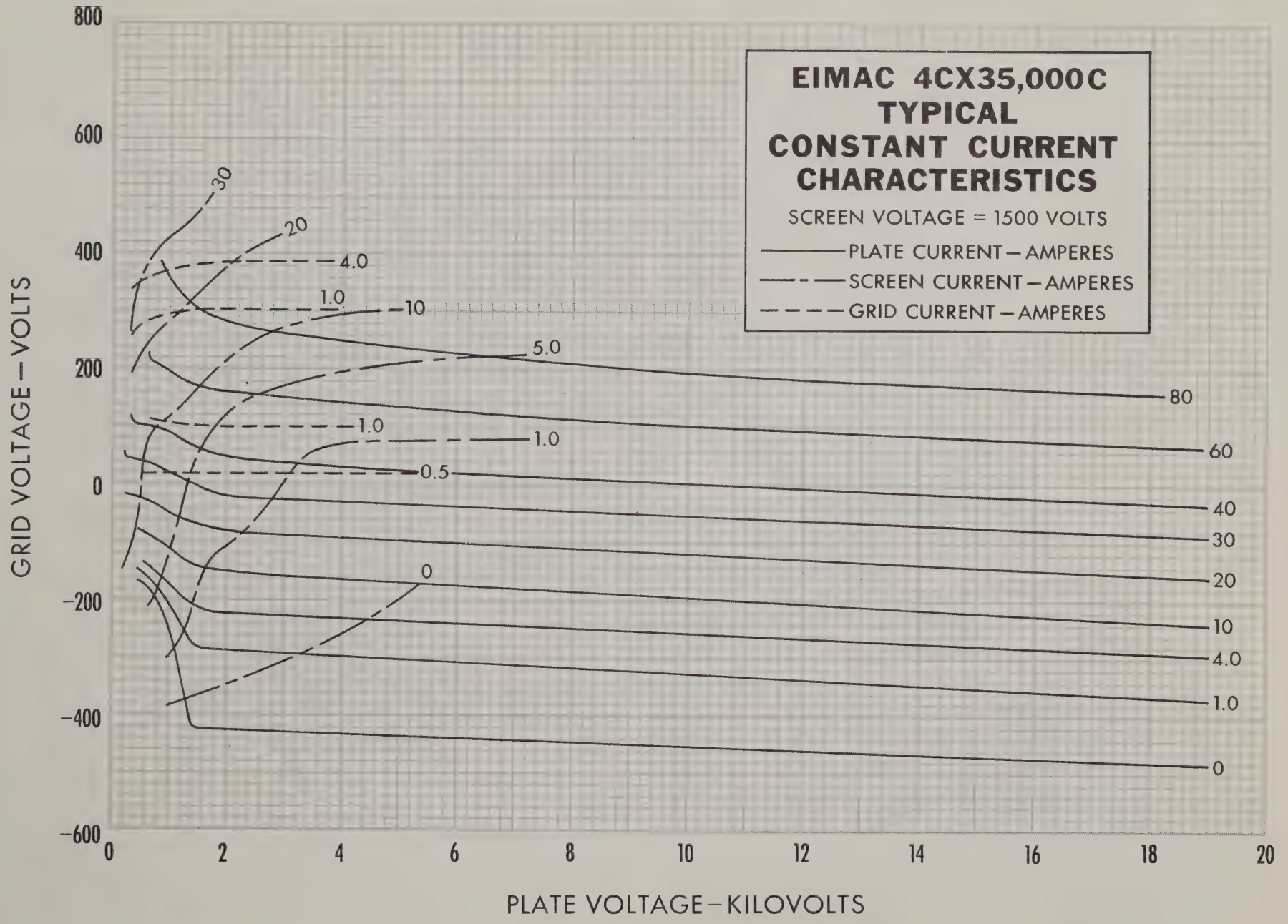




SECTION A–A
ROTATED 180°

▶ Indicates change from sheet dated 10-10-62.


EIMAC 4CX35,000C
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE – KILOVOLTS
20
10.0
10
6.0
5.0
2.0
1.0
1.0
50
40
30
20
10
5.0
1.0
0
0


EIMAC 4CX35,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
800
600
400
200
0
-200
-400
-600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE – KILOVOLTS
30
20
4.0
1.0
10
5.0
80
1.0
1.0
60
0.5
40
30
0
20
10
4.0
1.0
0

8172
4X150G

RADIAL-BEAM POWER TETRODE



The Eimac 8172/4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-volatge. The combination of a high ratio of transconductance to capacitance and a plate dissipation capability of 250 watts makes the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megacycles, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megacycles an output power of 50 watts per tube is obtained with a power-gain of five.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-heater Potential	-	-	150	volts
Heater: Voltage	-	2.5		volts
Current	6.2		7.3	amperes
Amplification Factor (Grid-to-Screen)	-	5		

Direct interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	25.0	29.0	uuf
Output	4.0	4.9	uuf
Feedback	-	0.05	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.	
Input	14.5	19	uuf
Output	4.0	4.9	uuf
Feedback	-	0.01	uuf

Frequency for Maximum Ratings (CW)	-	500 Mc
(Pulsed)	-	1500 Mc

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175°C
Ceramic-to-Metal-Seals	250°C
Anode Core	250°C
Operating Position	Any
Maximum Dimensions:	
Height	2.75 inches
Diameter	1.635 inches
Cooling	Forced Air
Net Weight	6 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	—250 MAX. VOLTS
DC PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 165Mc				500Mc	
DC Plate Voltage	600	750	1000	1250	1250	volts
DC Screen Voltage	250	250	250	250	250	volts
DC Grid Voltage	—75	—80	—80	—90	—80	volts
DC Plate Current	200	200	200	200	200	mA
DC Screen Current*	37	37	30	20	7	**mA
DC Grid Current*	10	10	10	10	10	**mA
Peak RF Grid Voltage*	90	95	95	105	—	volts
Driving Power*	0.7	0.7	0.7	0.8	10	**watts
Plate Input Power	120	150	200	250	250	watts
Plate Output Power	85	110	150	195	140	**watts

*Approximate values.
**Measured values for a typical cavity amplifier circuit.

(Effective 8-15-63) © Copyright 1959, 1962, 1963 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 10-21-59

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1000 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	—250 MAX. VOLTS
DC PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 165 Mc)

DC Plate Voltage	600	800	1000 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	—95	—100	—105 volts
DC Plate Current	200	200	200 mA
DC Screen Current*	35	25	20 mA
DC Grid Current*	8	10	15 mA
Peak RF Grid Input Voltage*	120	120	125 volts
Driving Power*	1	1.5	2 watts
Plate Input Power	40	60	60 watts
Plate Output Power	120	160	200 watts

*Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC GRID VOLTAGE	—250 MAX. VOLTS
DC PLATE CURRENT (AVERAGE)	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 216 Mc., 5-Mc. bandwidth)

DC Plate Voltage	750	1000	1250 volts
DC Screen Voltage	300	300	300 volts
DC Grid Voltage	—60	—65	—70 volts
During Sync-Pulse Peak:			
DC Plate Current	335	330	305 mA
DC Screen Current	50	45	45 mA
DC Grid Current	15	20	25 mA
Peak RF Grid Voltage	85	95	100 volts
RF Driver Power (approx.)	7	8	9 watts
Useful Power Output	135	200	250 watts
Black Level:			
DC Plate Current	245	240	230 mA
DC Screen Current	20	15	10 mA
DC Grid Current	4	4	4 mA
Peak RF Grid Voltage (approx.)	65	70	75 volts
RF Driver Power (approx.)	4.25	4.7	5.5 watts
Plate Power Input	185	240	290 watts
Useful Power Output	75	110	140 watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 MAX. VOLTS
PULSED SCREEN VOLTAGE	1500 MAX. VOLTS
DC GRID VOLTAGE	—500 MAX. VOLTS
MAXIMUM PULSE DURATION	5 MICROSECONDS
PULSED CATHODE CURRENT	7 MAX. AMPS
AVERAGE POWER INPUT	250 MAX. WATTS
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200-Mc.

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Current	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	—200	—250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 usec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 165 Mc, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1250	volts
DC Screen Voltage	350	350	volts
DC Grid Voltage*	—55	—55	volts
Zero-Signal DC Plate Current	100	100	mA
Peak RF Grid Voltage**	50	50	volts
DC Plate Current	250	250	mA
DC Screen Current**	10	9	mA
Plate Input Power	250	310	watts
Plate Output Power	120	170	watts
Two-Tone Average DC Plate Current	190	190	mA
Two-Tone Average DC Screen Current**	2	—1	mA

*Approximate values.

**Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X150G may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling—The 4X150G requires sufficient forced air to keep the glass-to-metal seals below 175°C and the ceramic-metal seals and anode core below 250°C. The air flow must be started when power is applied to the heater and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 175°C and the center heater terminal below 250°C.

The air requirements stated above are based on operation at sea level and an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow.

Temperature of the external parts of a tube may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd street, New York 11, N. Y.

ELECTRICAL

Heater—The rated heater voltage for the 4X150G is 2.5 volts, and should be maintained at this value plus or minus five percent. At frequencies above 400 megacycles, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 1000 Mc.

Frequency, Mc	Filament
up to 400	2.5 volts
401 to 1000	2.2 volts
1001 to 1500	2.0 volts

Cathode—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 Mc, drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 Mc in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

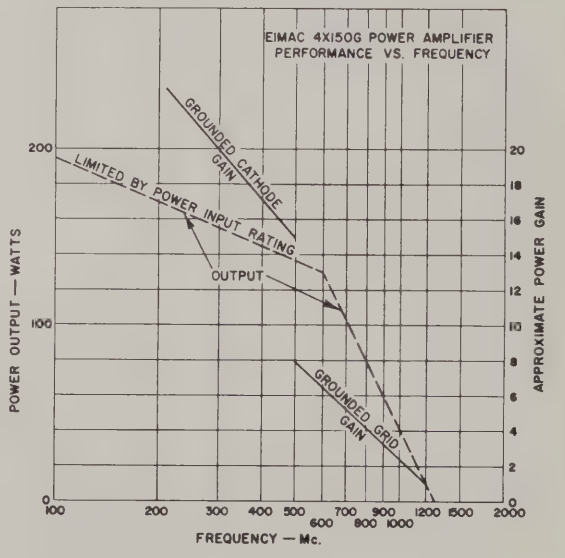
Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150G.

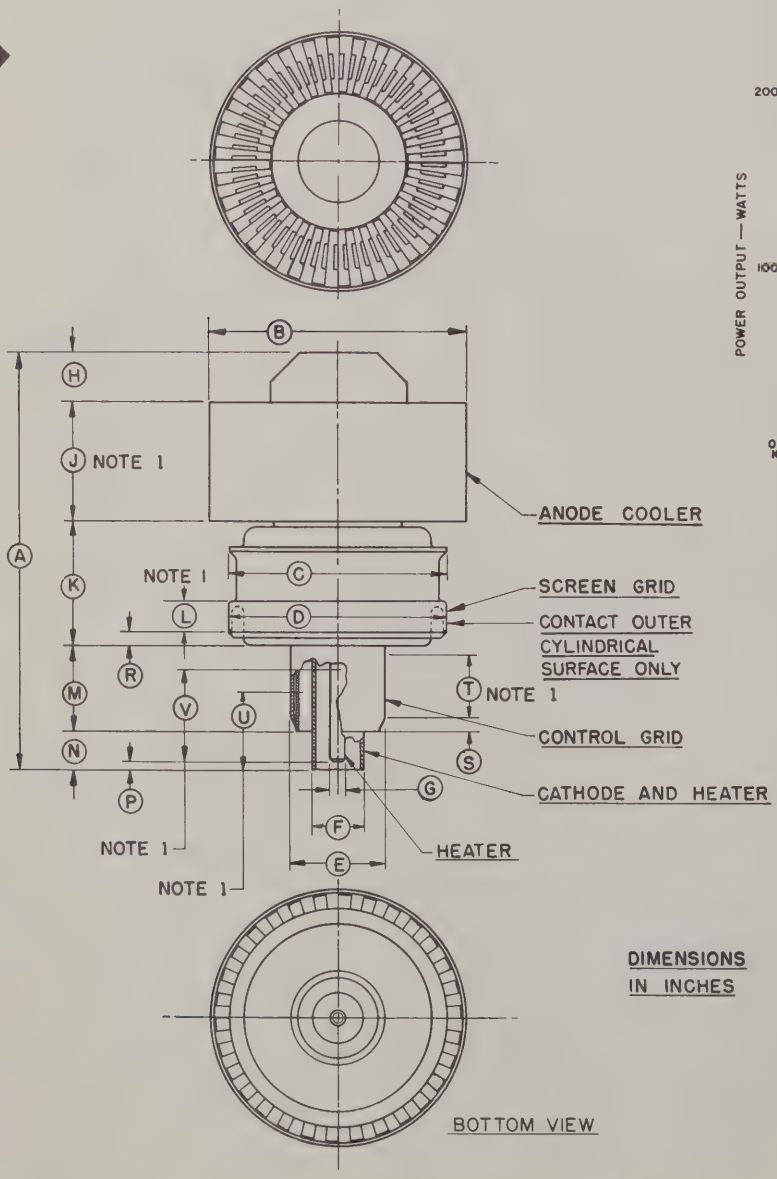
Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

UHF Operation—The 4X150G is suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough Inc., San Carlos, California, for information and recommendations.

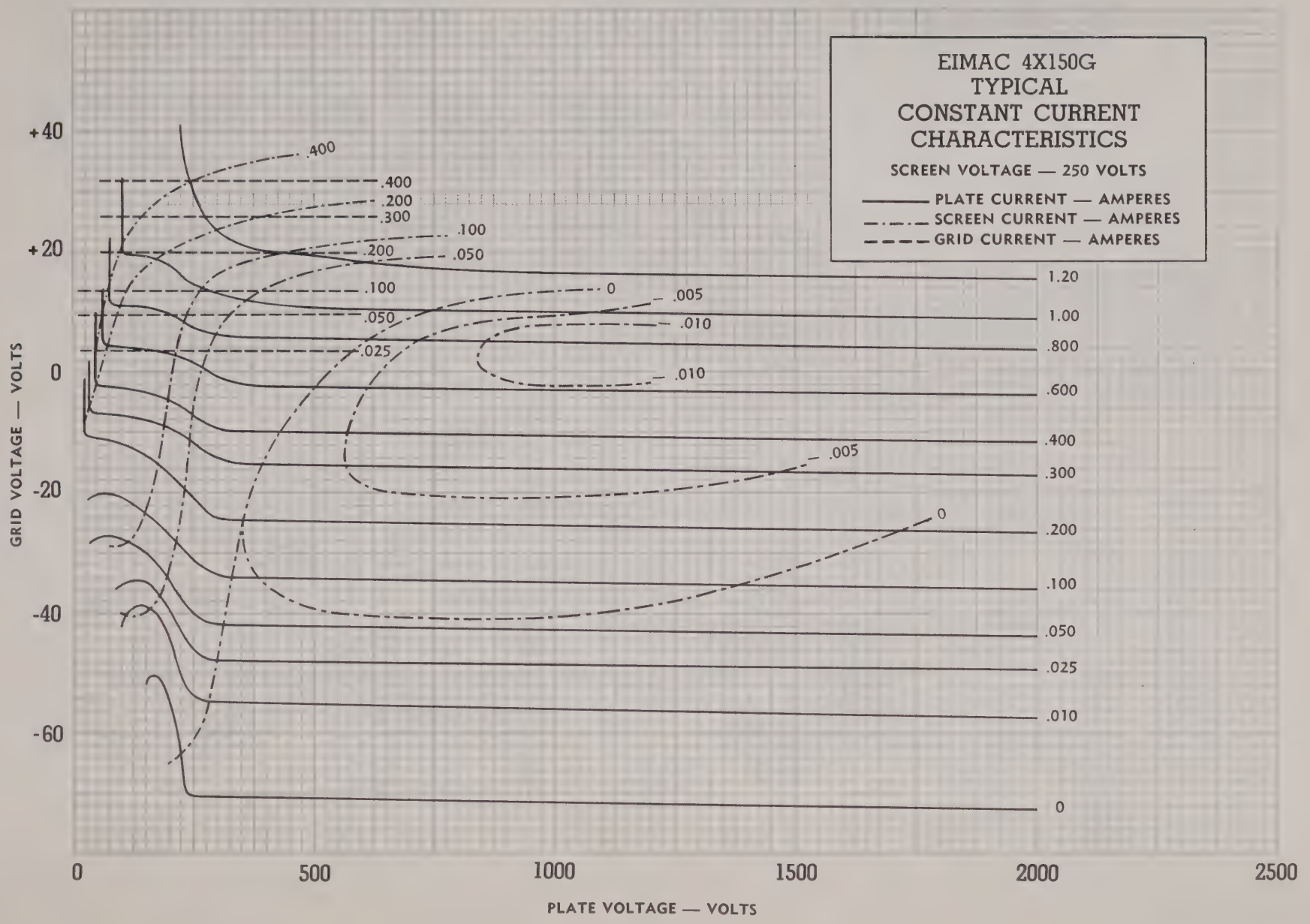


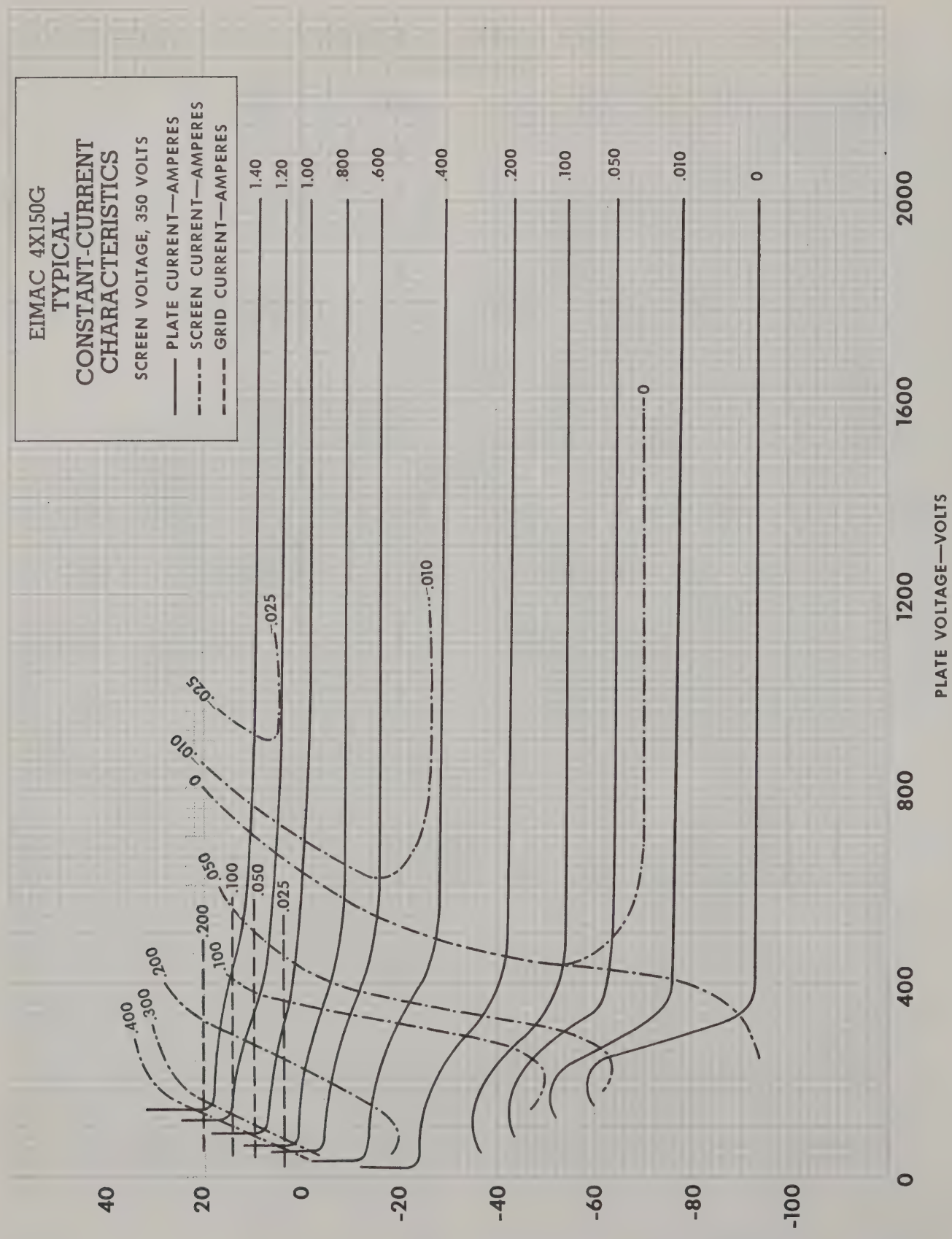


DIMENSION			
REF	NOMINAL	MINIMUM	MAXIMUM
A			2 3/4
B		1.615	1.635
C			1.406
D		1.417	1.433
E		.587	.597
F		.317	.327
G		.088	.098
H			5/16
J		23/32	25/32
K		3/4	13/16
L		3/16	
M		.500	.578
N		15/64	17/64
P		1/32	1/16
R	3/32		
S	1/8		
T		11/32	
U		13/32	
V		15/32	

NOTE 1. LENGTH AVAILABLE FOR CONTACT.

▶ Indicates change from sheet dated 10-21-59


EIMAC 4X150G
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
+40
+20
0
-20
-40
-60
PLATE VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.200
.300
.100
.200
.050
.100
.050
.025
0
.005
.010
.010
.005
0


EIMAC 4X150G
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.025
.050
.100
.200
.300
.400
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000

EITEL-McCULLOUGH, INC.

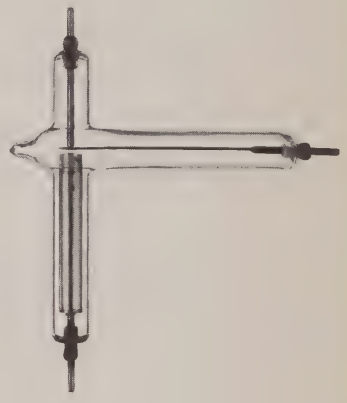
VS-2
VS-4
VS-5
VS-6

VACUUM SWITCH

Eimac VS-2, VS-4, VS-5 and VS-6 are single pole, double throw, electro-magnetically actuated vacuum switches designed for high voltage applications where a compact, fast-acting vacuum switch is required.

The VS-2, VS-4 and VS-5 are identical electrically and are intended for switching radio-frequency circuits at moderate values of current. These three switches differ only in physical characteristics; the VS-4 being shorter and the VS-5 being of more rugged construction.

The VS-6 has a tungsten contact arm to minimize sticking and is intended for pulse switching applications where high peak currents are encountered. These switches are designed to be used with Eimac 12 volts and 24 volts direct-current coils.



GENERAL CHARACTERISTICS

ELECTRICAL

	VS-2	VS-4	VS-5	VS-6	
Peak RF hold-off voltage	20,000	20,000	20,000	22,000	volts
RF Contact Current (1-15 Mc)	7.5	7.5	7.5		amps
(30 Mc)	5.0	5.0	5.0		amps
Pulse Current				150	amps

(Note) Pulse duration less than 2.5 milliseconds, pulse repetition rate less than 400 pps, Pulse train = 0.5 seconds. With 0.25 second pulse train, this rating increases to 300 amps).

Maximum Contact Resistance:

Normally closed contact	0.03	0.03	0.03	0.03	ohms
Normally open contact	0.05	0.05	0.05	0.03	ohms
Maximum Contact closing time	20	20	20	20	millisec.

MECHANICAL

Dimensions		See drawings
Weight		2 ounces

Coil Data:	12 volt coil	24 volt coil	
Part Number	512705	51273	
Resistance (nominal)	30	115	ohms

(Effective 12-1-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

APPLICATION

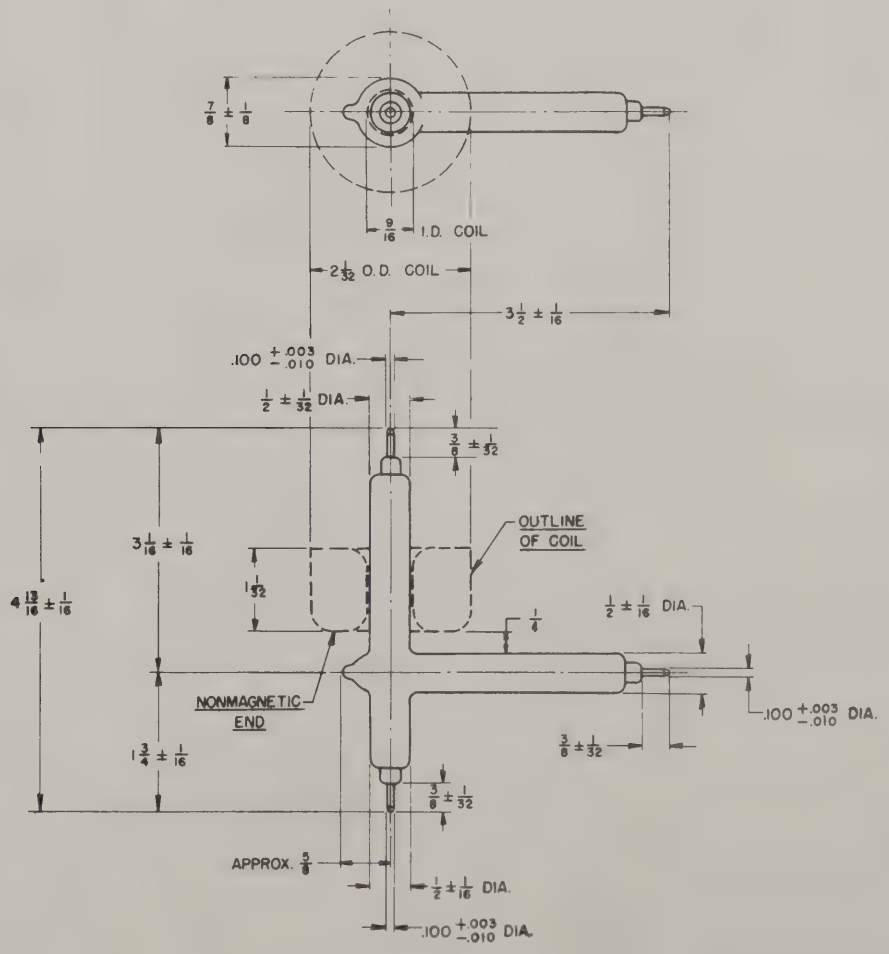
Mounting: The operating coil is mounted in rubber grommets over the glass barrel on the arm containing the iron core. The non-magnetic end of the coil is placed toward the contacts with approximately 1/16 inch clearance between the coil and the glass barrel containing the movable contact arm.

In order to prevent damage from shock and vibration, the switch should be fastened to the equipment with rubber covered metal strips over the glass tubing. Where vibration and shock are encountered, the heavier VS-5 switch is preferred.

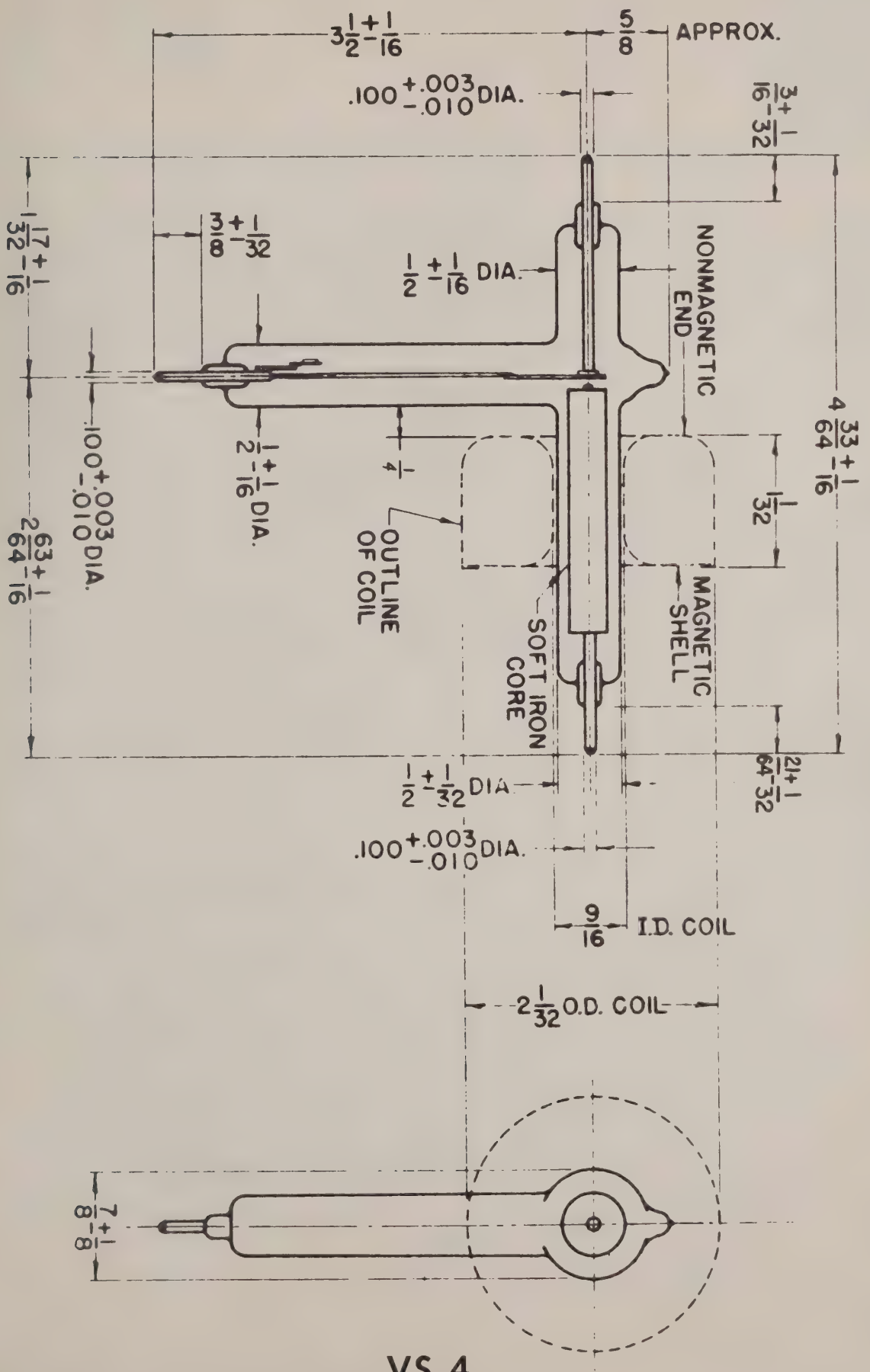
Contacts: The normally open contact is housed in the glass barrel containing the iron core; the normally closed contact being directly opposite this core.

DC Ratings: While not designed for dc applications, the VS series may be used at reduced ratings in dc service. The following ratings have been established:

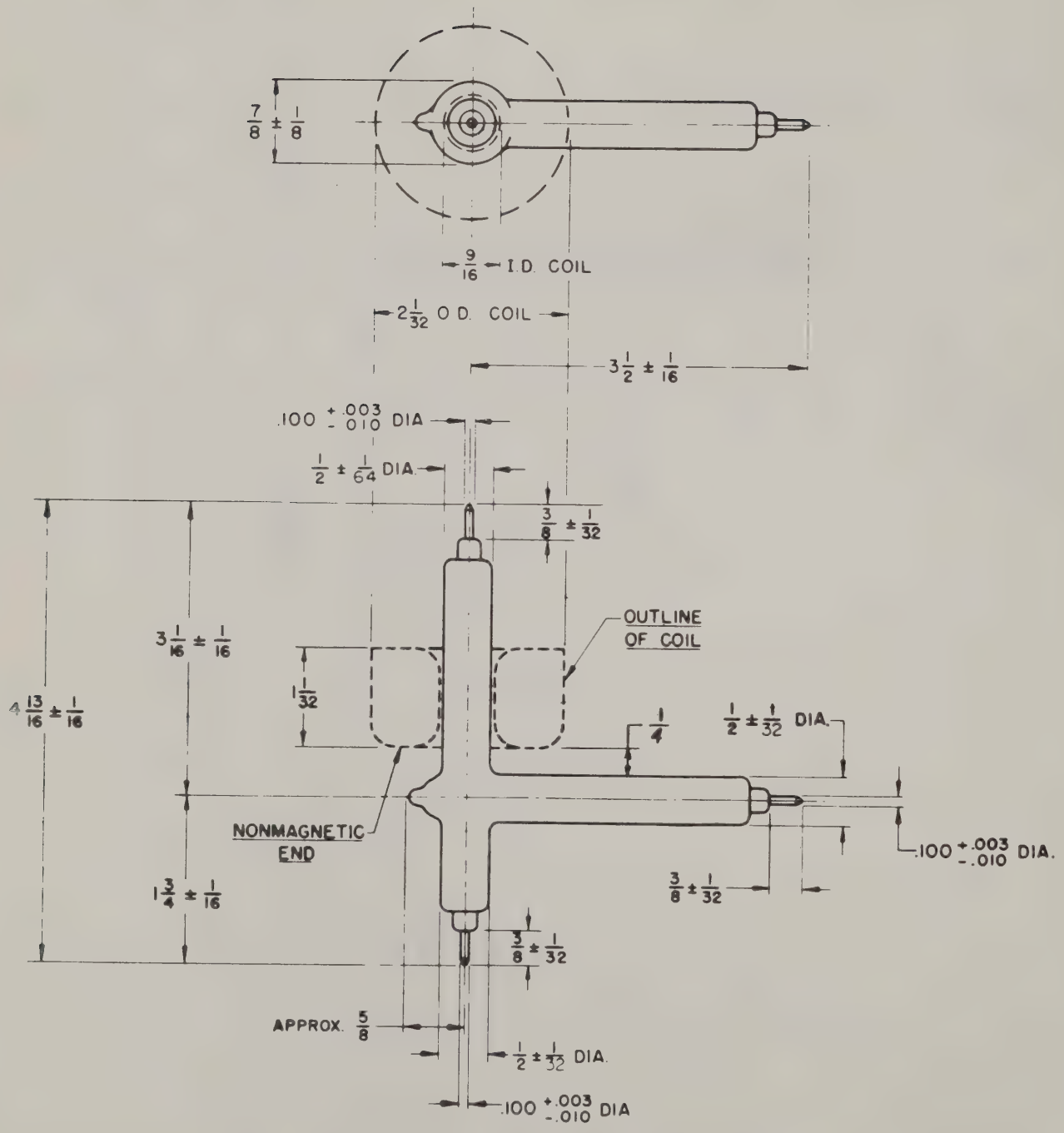
	VS-2	VS-4	VS-5	VS-6	
DC Voltage - - - - - - - -	14,000	14,000	14,000	14,000	volts
DC Current - - - - - - - -	4	4	4	6	amps



VS-2
VS-5


3 1/2 +1/16
5/8 APPROX.
.100 +.003 -.010 DIA.
3/16 +1/32
1 17/32 +1/16
3/8 +1/32
1/2 +1/16 DIA.
NONMAGNETIC END
4 33/64 +1/16
.100 +.003 -.010 DIA.
2 63/64 +1/16
1/2 +1/16 DIA.
1/4
OUTLINE OF COIL
1/32
SOFT IRON CORE
MAGNETIC SHELL
21/64 +1/32
1/2 +1/32 DIA
.100 +.003 -.010 DIA.
9/16 I.D. COIL
2 1/32 O.D. COIL
7/8 +1/8

VS-4


7/8 ± 1/8
9/16 I.D. COIL
2 1/32 O.D. COIL
3 1/2 ± 1/16
.100 +.003 -.010 DIA
1/2 ± 1/64 DIA.
3/8 ± 1/32
OUTLINE OF COIL
3 1/16 ± 1/16
4 13/16 ± 1/16
1 1/32
1/4
1/2 ± 1/32 DIA.
NONMAGNETIC END
.100 +.003 -.010 DIA.
1 3/4 ± 1/16
3/8 ± 1/32
3/8 ± 1/32
APPROX. 5/8
1/2 ± 1/32 DIA.
.100 +.003 -.010 DIA

VS-6

Eimac

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-306
SK-316

AIR-SYSTEM CHIMNEYS

The SK-306 and SK-316 Air-System Chimneys are intended for use with the tube and socket combinations listed below. They are used to direct cooling air to the tube's anode cooling fins after it has been forced through the companion Air-System Socket.

MATERIALS

These chimneys are molded from a white thermosetting polyester premix compound per MIL-R-7575.

INSTALLATION

The SK-306 mounts above the chassis or plenum and is secured by the eight mounting screws that secure the SK-300 or SK-300A socket.

The SK-316 mounts above the chassis with four separate mounting screws on 8-15/16" diameter pitch circle.



SK-306 Chimney shown with 4CX5000A and SK-300 socket.

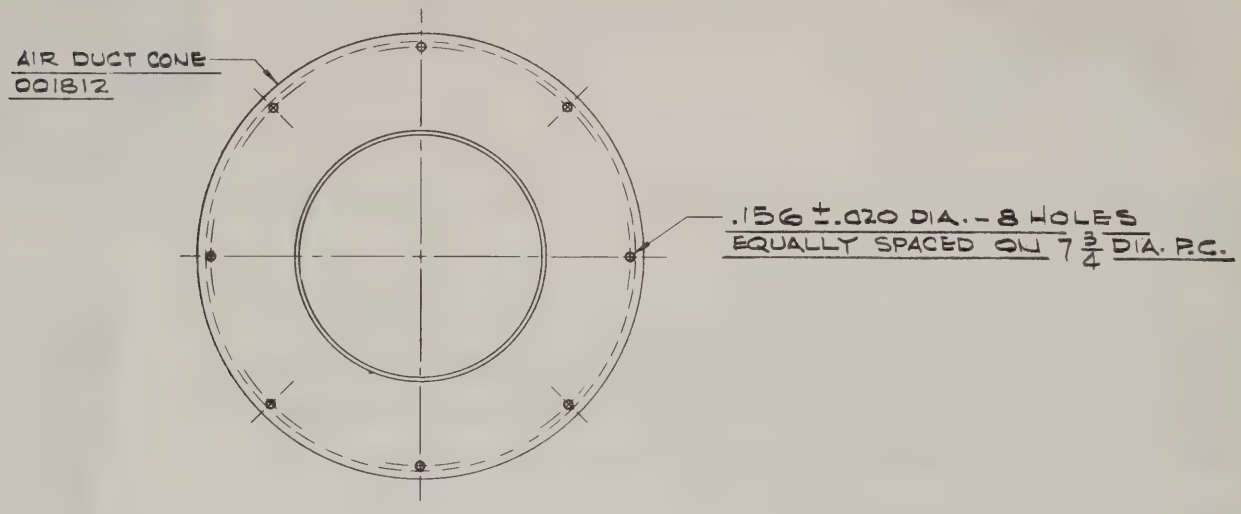
CHIMNEY/TUBE/SOCKET COMBINATIONS

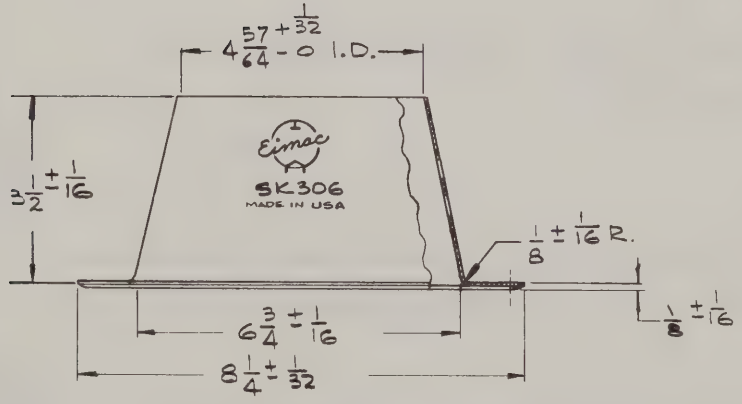
CHIMNEY	TUBE	SOCKET
SK-306	4CX5000A 4CX5000R	SK-300
SK-316	4CX15,000A	SK-300A

Net Weight - - - - - - - - SK-306 - 5.5 ounces

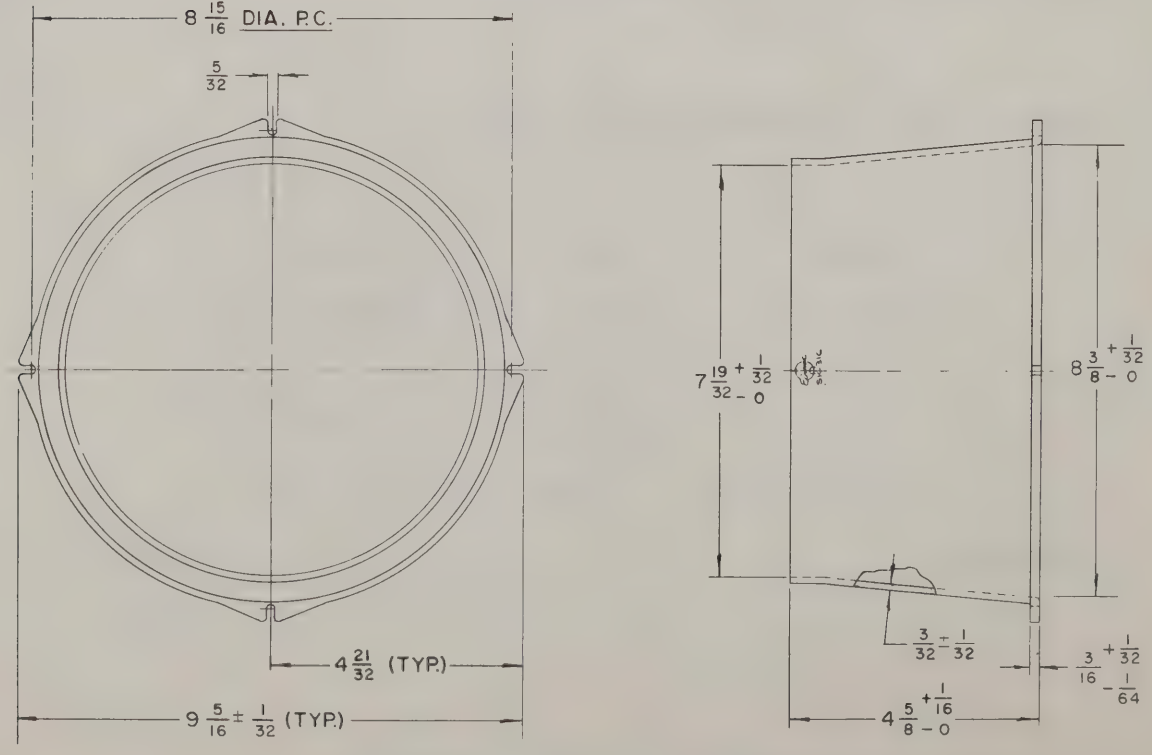
SK-316 - 11 ounces

(Effective 5-21-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.


AIR DUCT CONE
001812
.156 ± .020 DIA. - 8 HOLES
EQUALLY SPACED ON 7 3/4 DIA. P.C.


4 57/64 +1/32 - 0 I.D.
3 1/2 ± 1/16
Eimac
SK306
MADE IN USA
1/8 ± 1/16 R.
6 3/4 ± 1/16
8 1/4 ± 1/32
1/8 ± 1/16

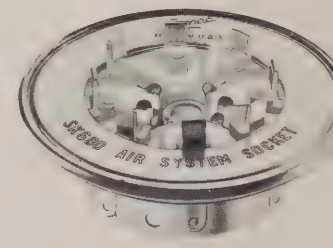
SK-306


8 15/16 DIA. P.C.
5/32
4 21/32 (TYP.)
9 5/16 ± 1/32 (TYP.)
7 19/32 + 1/32 - 0
8 3/8 + 1/32 - 0
3/32 ± 1/32
3/16 + 1/32 - 1/64
4 5/8 + 1/16 - 0

SK-316

SK-600A

AIR-SYSTEM SOCKET



The Eimac SK-600A is one of the air-system sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-606A Air-Chimney is available and is recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor.

BASE CONNECTIONS

The SK-600A Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance; these contact terminals are insulated from the socket body.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low inductance screen by-pass capacitor, 2700 $\pm$ 500 uuf, which provides a short radio-frequency path to ground. The capacitor contains a silvered-mica dielectric and is rated at 400 volts dc. The SK-600A differs from the SK-620A in that the screen by-pass capacitor is sealed with an encapsulating material to keep out foreign matter and to insure reliable performance under high humidity or moisture conditions.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS and FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of -196°C to + 199°C and it is resistant to embrittlement and thermal shock.

INSTALLATION

The SK-600A Air-System Socket can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-1/4" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

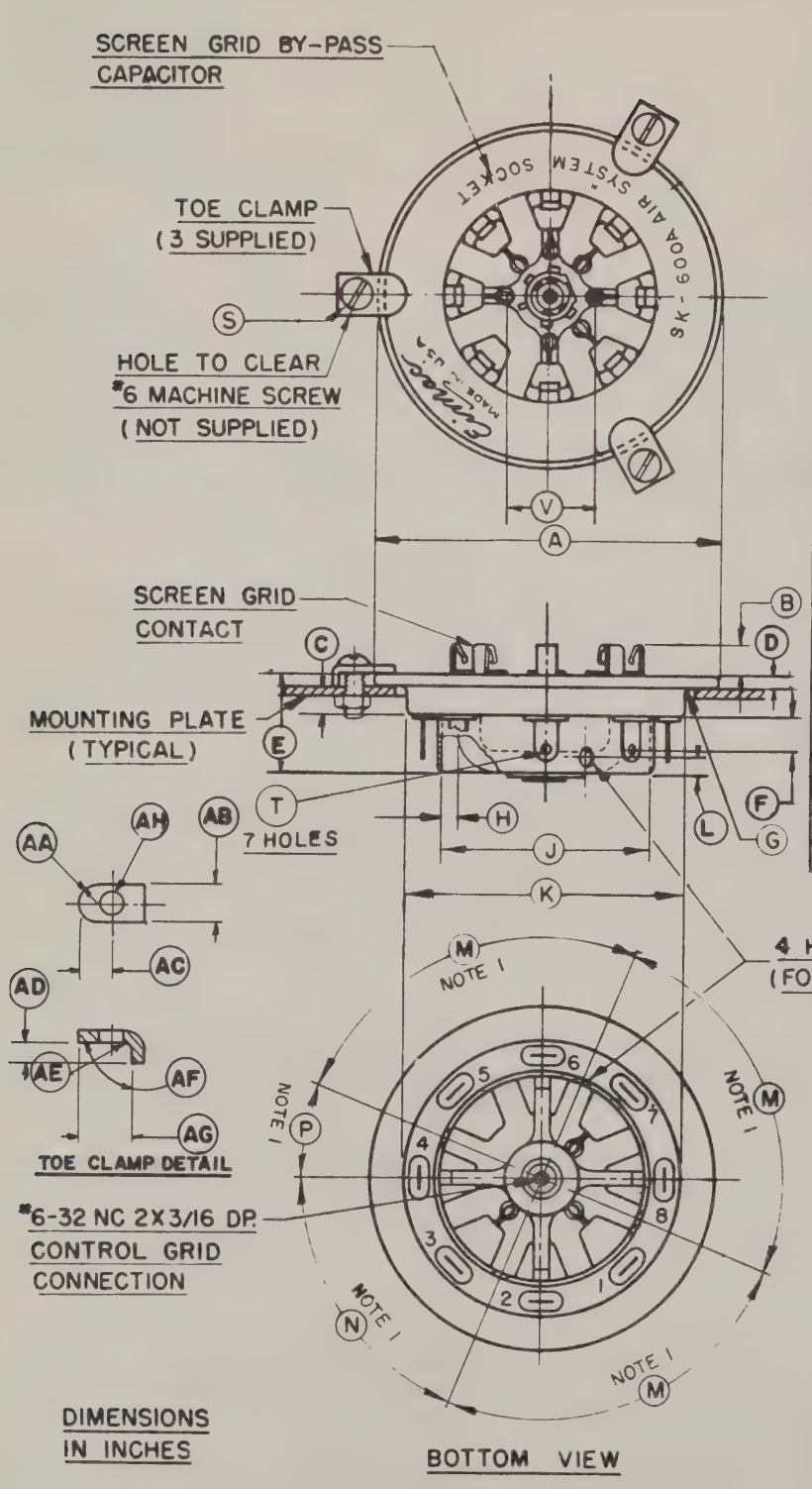
If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-5/8" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

The SK-600A Air-System Socket Is Recommended For Use With The Following Tubes:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

NET WEIGHT . . . . . 3.5 ounces

(Effective 5-9-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.



DIMENSIONS IN INCHES

BOTTOM VIEW

DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B	.234	.266	
C	.203	.235	
D	.125	.157	
E	.844	906	
F			.250
G		.031R	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE *1	91° NOTE *1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T			.090 DIA.
V			.687 DIA.
AA	.125R	.187R	
AB	.292	.332	
AC	.292	.332	
AD	.105	.145	
AE		.062R	
AF	80°	100°	
AG	.417	.457	
AH	.142	.146	

CONNECTIONS

NO. 1 SCREEN GRID
" 2 CATHODE
" 3 HEATER
" 4 CATHODE
" 5 NO CONNECTION
" 6 CATHODE
" 7 HEATER
" 8 CATHODE

NOTES:
1.- TOLERANCES ARE NOT CUMULATIVE
2. CAPACITANCE 2700MMFD ±18.5%, VOLTAGE 2000VDC TEST, 1000WVDC. SEALED TO WITHSTAND HUMIDITY AND SALT SPRAY PER MIL-STD-202B

SK-1306
SK-1406

AIR-SYSTEM CHIMNEYS

EITEL-McCULLOUGH, INC.

The SK-1306 and SK-1406 Air-System Chimneys are intended for use with the tube and socket combinations listed below. They are used to direct cooling air to the tube's anode cooling fins after it has been forced through the companion Air-System Socket.

MATERIALS

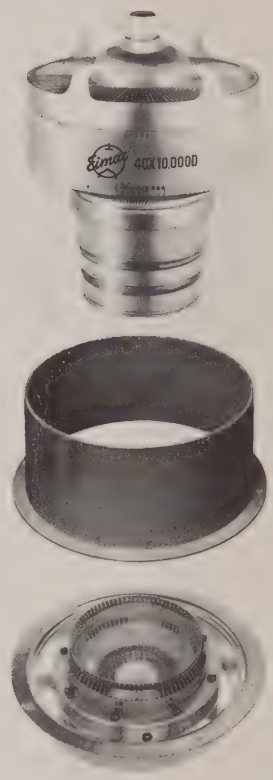
These chimneys are molded from a grey, thermosetting polyester premix compound per MIL-R-7675.

INSTALLATION

The SK-1306 and SK-1406 Air System Chimneys are mounted above the chassis or pressurized compartment, directly over the companion socket. The chimneys are secured by the eight equally spaced machine screws on a 7-3/4" P.C. that are used to install the socket.

CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-1306	3CX10,000A1 3CX10,000A3 3CX10,000A7	SK-1300
	4CX10,000D	SK-300 SK-300A
SK-1406	4CX3000A	SK-1400A SK-1470A



SK-1306 Chimney shown with 4CX10,000 and SK-300 socket.

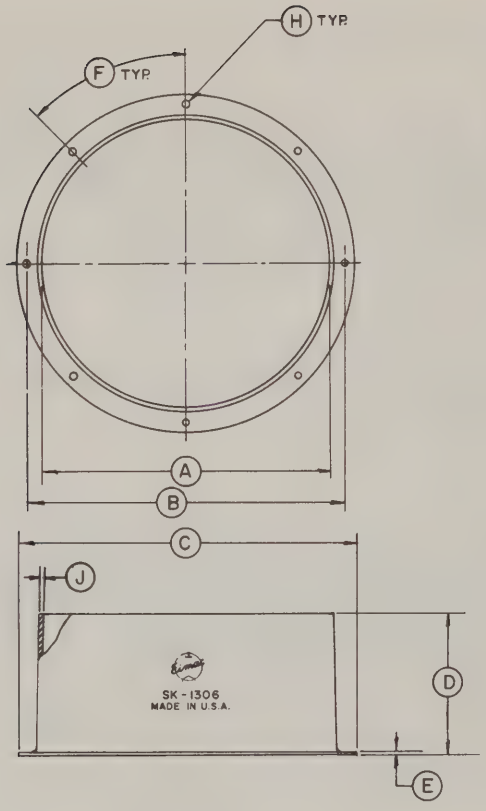
Net Weight - - - - - SK-1306 - 8 ounces

SK-1406 - 7 ounces

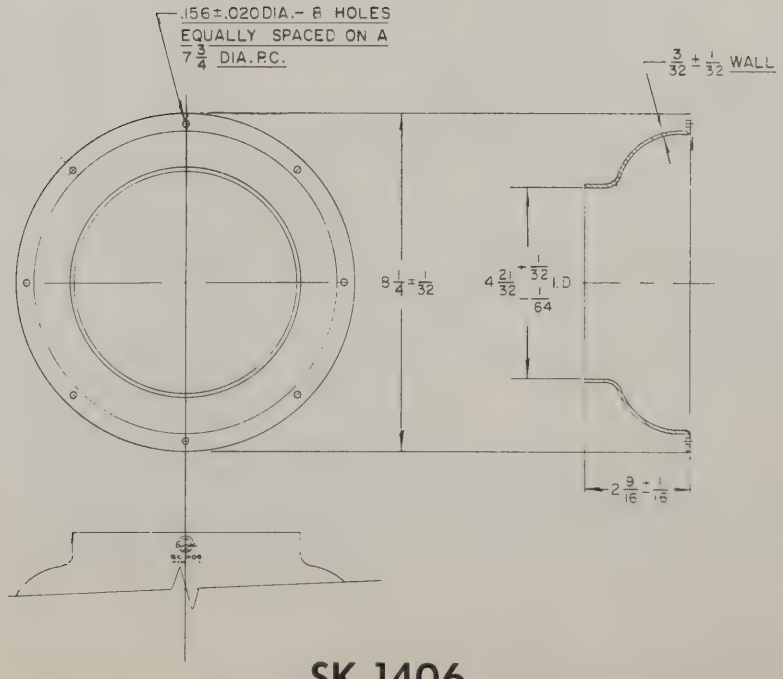
(Effective 5-17-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN	MAX	NOM.
A	7.062	7.094	
B	7.734	7.766	
C	8.230	8.265	
D	3.609	3.656	
E	.093	.125	
F	44°	46°	
H	.140	.172	
J	.062	.109	



SK-1306

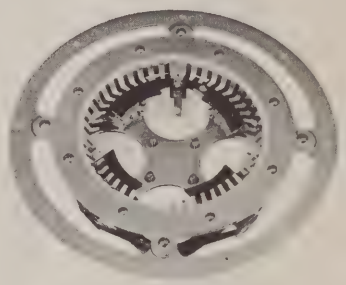


SK-1406

EITEL-McCULLOUGH, INC.

SK-1400A
SK-1470A

AIR-SYSTEM SOCKETS



The Eimac SK-1400A and SK-1470A Air-System Sockets are intended for use with the 4CX3000A and the 4CV8000A. The SK-1400A incorporates an integral screen by-pass capacitor and has no grounded contacts. The SK-1470A does not include a by-pass capacitor but does have the screen contacts grounded to the socket mounting plate.

BASE CONNECTIONS

A continuous screen grid contact finger assembly is provided for making contact with the solid screen ring flange on the 4CX3000A or 4CV8000A. Grid and filament connections to the tube are made by four rows of contact tab assemblies that provide for breech-block electrical and mechanical contact.

Each grid contact is terminated in two machine screws at the bottom of the socket base. Filament connections are to a terminal strap and to the socket base.

BY-PASS CAPACITOR

The SK-1400A is provided with an integral 1800$\mu\mu$f screen by-pass capacitor rated at 1000 volts dc. The screen contact fingers are attached to one side of this capacitor. The SK-1470A does not contain this capacitor; instead the screen contacts are grounded directly to the socket shell.

INSTALLATION

When mounted on a chassis or pressurized compartment, a 7-1/4" diameter hole is required for the socket. The socket is secured by eight #6 screws on a 7-3/4" bolt circle. These same screws are used to install the companion SK-1406 chimney used with the air-cooled 4CX3000A.

MATERIALS

The contact fingers and tabs are a non-ferrous spring alloy, heat-treated and silver-plated. The socket body is made of silver-plated brass.

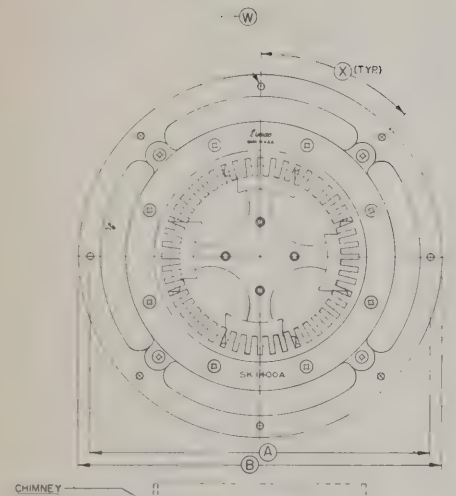
CHIMNEY

The SK-1406 chimney is available for use with the SK-1400A or SK-1470A and the air-cooled 4CX3000A. It effectively directs air that has passed through the socket into the anode cooling fins.

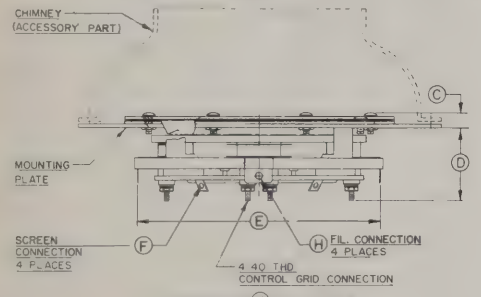
Note: Where a "floating" socket is desired - especially for the 4CV8000A - the SK-1490 is available. This is a SK-1470 without the mounting ring and is intended for use where the tube is fixed and the socket is to be removable.

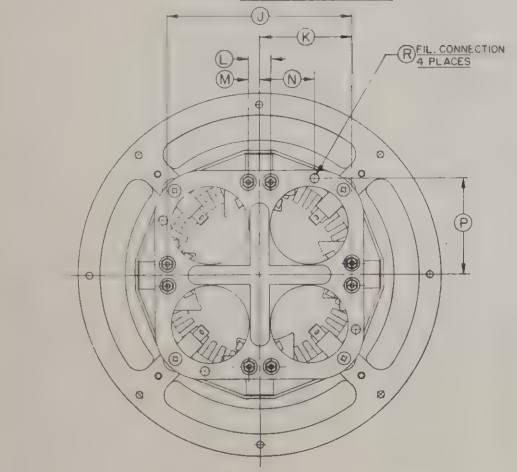
NET WEIGHT . . . . . 30 ounces

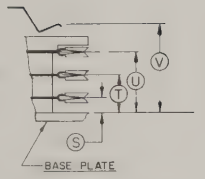
Effective (5-9-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.



DIMENSIONAL DATA			
REF	MAX	MIN.	NOM
A	7.766 DIA. P.C.	7.734 DIA. P.C.	
B	8.266 DIA.	8.234 DIA.	
C	.354	.312	
D	1.697	1.657	
◇1 E	5.540	5.509	
F	.14. DIA.	.109 DIA.	
H	.176	.166	
J	4.207	4.197	
K	2.106	2.096	
L	.506	.494	
M	.253	.247	
N	1.266	1.234	
P	2.203	2.171	
R	.208 DIA.	.198 DIA.	
S	.181	.169	
◇ T	.445	.425	
U	.729	.701	
◇1 V	1.122	1.090	
◇2 W	.153 DIA.	.142 DIA.	
X	46°	44°	

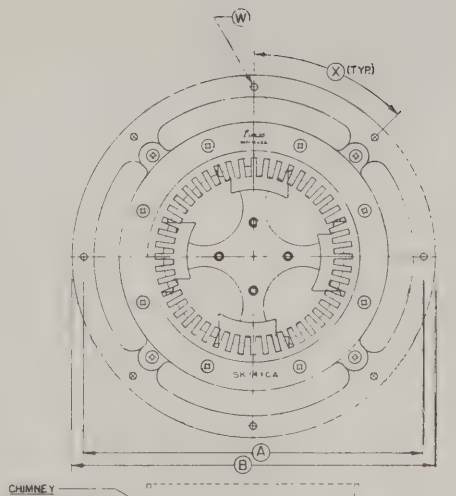




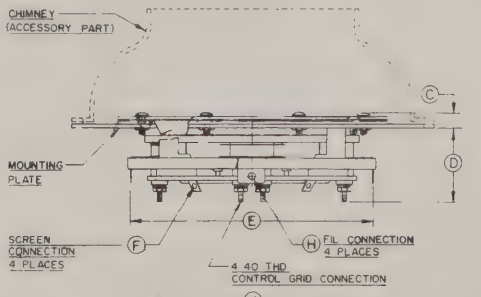


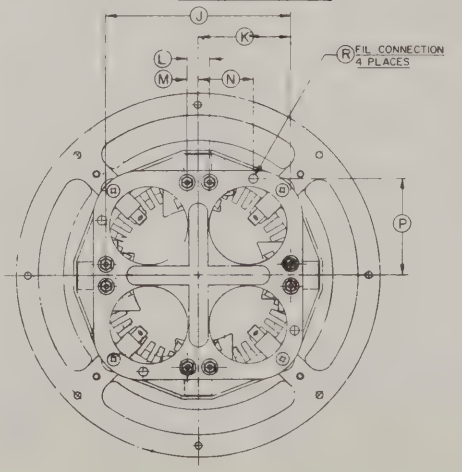
CONTACT DIMENSIONS

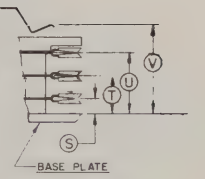
SK-1400A



DIMENSIONAL DATA			
REF	MAX	MIN	NOM
A	7.766 DIA PC	7.734 DIA PC	
B	8.266 DIA	8.234 DIA	
◇1 C	.354	.312	
D	1.697	1.657	
◇1 E	5.540	5.509	
F	.141 DIA	.109 DIA	
H	.176	.166	
J	4.207	4.197	
K	2.106	2.096	
L	.506	.494	
M	.253	.247	
N	.266	1.234	
P	2.203	2.7	
R	.208 DIA	.198 DIA	
S	.181	.169	
◇ T	.445	.425	
U	.729	.701	
◇1 V	1.122	1.090	
◇2 W	.152 DIA	142 DIA	
X	46°	44°	







CONTACT DIMENSIONS

SK-1470A

EITEL-McCULLOUGH, INC.
SAN CARLOS, CA

TABLE OF CONTENTS

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	5-15-64
Eimac and EIA Tube Number Cross Reference Sheet	February '64
Power Frequency Chart for Power Grid	———
Power Frequency Chart for CW Power Klystrons	———
Power Frequency Chart for Pulse Power Klystrons	———

DIODES — RECTIFIERS — PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	7-1-52
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020 (100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	12-1-63
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	4-9-64
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CW25,000A3	11-1-63
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX10,000A1/8158	1-1-63
3CX10,000A3/8159	10-20-61
3CX10,000A7/8160	11-1-63
3CX15,000A3	4-11-64
3W5000A1/8240	2-18-63
3W5000A3/8242	6-1-64
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61
3X2500F3/8251	6-30-64
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51

TRIODES (Continued)	Effective Date
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	7-21-58
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50

TETRODES — PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CS100L	4-20-64
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C, F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61
4CX300A/8167	12-1-63
4CX300Y	11-1-63
4CX350A/8321 & 4CX350F/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	11-4-63
4CX1000K/8352	1-1-64
4CX3000A/8169	3-1-63
4CX5000A/8170	2-15-63
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	6-15-60
4X150G/8172	8-15-63
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
7580	3-31-61
4E27A/5-125B	8-15-52

POWER KLYSTRONS	
3K2500LX	9-15-58
3K2500SG	4-22-58
3K3000LQ	6-6-58
3K50,000LA, F, Q	5-9-58
3KM3LB	4-1-63

*Not recommended for New Equipment Design.

POWER KLYSTONS (Continued)

	Effective Date
3KM300LA	3-15-64
3KM3000LA	6-6-58
3KM4000LT	11-15-62
3KM50,000PA	7-15-60
4K3CB	10-16-62
4K3SJ	10-26-62
4K3SK	3-15-64
4K50,000LQ	5-28-58
4KM50LB	4-2-63
4KM50SK	5-2-63
4KM70SJ	3-15-62
4KM100LA	9-25-62
4KM3000LQ	9-1-60
4KM3000LR	10-1-60
4KM50,000LA3	10-20-61
4KM50,000LF	10-20-61
4KM50,000LQ	8-15-60
4KM50,000LR	10-20-61
4KM170,000LA	10-1-60
4KMP10,000LF	10-1-60
5K210,000LQ	10-20-61
5KM70SF	11-15-62
X602K	11-15-62
X626AC	10-20-61
X700	4-25-61

WATER LOAD

WL-120, 130, 140	6-1-64
WL-150	11-1-63

REFLEX KLYSTRONS TWT—VTM

REFLEX KLYSTRONS

1K20XD	———
1K20XD-A	12-27-62
1K20XD-S	12-29-62
1K20XF-B	4-1-64
1K20XK	———
1K20XN-A	12-27-62
1K20XS	———
1K015CA, CG	2-16-60
1K75CH, CK	———
1K75CLA	3-15-64
1K75CS	8-10-60
1K125CA	3-15-64
1K125CB	———
EM-1114	3-15-64
X1075	8-10-62
X1075-A	8-10-62
X1079	3-15-64
X1095	3-15-64
X1115	4-1-64
X1115A	3-5-63
X1115B	3-5-63
X1116	4-1-64
X1116A	3-5-63
X1116B	4-1-64
X1117	4-1-64
X1117A	4-1-64
X1117B	4-1-64
X1118	4-1-64
X1118A	4-1-64
X1118B	4-1-64
X1120	6-19-63
X1120B	6-19-63
X1123	4-1-64
X1126	4-1-64
X1126B	4-1-64
X1130	6-19-63
X1149	1-1-64

TWT

EM-108	3-15-64
EM-113	3-15-64
EM-114	3-15-64
EM-116	3-15-64
EM-118	3-15-64
EM-778/8198	4-1-62
EM-779	4-1-62
EM-1006	4-1-62
EM-1010	4-1-62
EM-1011	4-1-62
EM-1015	4-1-62

TWT (Continued)

	Effective Date
EM-1016	4-1-62
X1021	8-1-62
EM-1025	4-1-62
EM-1030	4-1-62
EM-1031	4-1-62
X1044	6-20-64
EM-1045	4-1-62
EM-1046	4-1-62
EM-1050	4-1-62
EM-1051	4-1-62
X1059	3-4-64
EM-1060	4-1-62
X1131	3-17-64
X1132	3-6-64

VTM

EM-747	3-15-64
EM-1080	6-14-63
X1081	2-15-63
X1083B	3-15-64
X1084	8-1-62
X1085	7-27-62
EM-1086	10-27-62
X1087	1-1-64
X1088B	3-15-64
X1091	10-27-62
X1092	3-5-63
EM-1093	3-15-64
X1094	3-15-64
X1097	6-14-63
X1098	3-1-64
X1099	3-15-64
X1150	3-15-64

TWO-CAVITY KLYSTRONS

X1111	3-15-64
X1113	3-15-64

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
SK-300	1-1-63
SK-306, SK-316	5-21-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	5-21-63
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890B, SK-806	4-9-64
SK-900, SK-906	6-1-60
SK-1300	5-9-63
SK-1306, SK-1406	5-17-63
SK-1400A, SK-1470A	5-9-63

CAVITY AMPLIFIER

EM-4500	1-1-64
EM-4501	11-1-63
EM-4506	1-1-64
EM-4507	11-1-63
EM-4512	1-1-64
EM-4515	1-1-64
EM-4516	11-1-63
EM-4523	1-1-64
EM-4524	2-1-64
X4539	3-5-63
X4540	3-5-63
X4546	9-1-63

Eimac

EITEL-McCULLOUGH, INC.

8164
3-1000Z

HIGH-MU POWER TRIODE

The Eimac 8164/3-1000Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8164/3-1000Z in a cathode driven circuit.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
▶ Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	21.5		23.0	amps
Amplification Factor (Average)		200		
Interelectrode Capacitance (Grounded Cathode)				
Input	15.0		19.0	pf
Output			0.3	pf
Grid-Plate	6.0		9.0	pf
Interelectrode Capacitance (Grounded-Grid)				
Input	15.0		19.0	pf
Output	6.0		9.0	pf
Plate-Cathode			0.3	pf
Frequency for Maximum Ratings			110	Mc

MECHANICAL

Base	5 Pin Special
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	Eimac HR-8
Recommended Socket	Eimac SK-510
Recommended Chimney	Eimac SK-516
Maximum Operating Temperatures:	
Plate Seal	225° C
Base Seals	200° C
Maximum Over-all Dimensions:	
Height	7.88 inches
Diameter	5.25 inches
Net Weight	1.2 pounds

RADIO FREQUENCY POWER AMPLIFIER, Class C

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 MAX. VOLTS
DC PLATE CURRENT	700 MAX. MA
GRID DISSIPATION	50 MAX. WATTS
PLATE DISSIPATION	1000 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	4500	6000 volts
DC Grid Voltage	—75	—100 volts
DC Plate Current	700	700 mA
DC Grid Current	240	250 mA
Peak RF Grid Voltage	200	230 volts
Grid Driving Power	48	57 watts
Power Output	2250	3200 watts

▶ Indicates change from sheet dated 3-20-62

(Effective 4-9-64) © Copyright 1962, 1964 by Eitel-McCullough, Inc.

PLATE MODULATED RF AMPLIFIER

Class C

MAXIMUM RATINGS	
DC PLATE VOLTAGE	4500 MAX. VOLTS
DC PLATE CURRENT	550 MAX. MA
GRID DISSIPATION	50 MAX. WATTS
PLATE DISSIPATION	670 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	4500 volts
DC Grid Voltage	—100 volts
DC Plate Current	500 mA
DC Grid Current	170 mA
Drive Power	35 watts
Output Power (carrier)	1765 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class B

MAXIMUM RATINGS	
DC PLATE VOLTAGE	6000 MAX. VOLTS
DC PLATE CURRENT	800 MAX. MA
GRID DISSIPATION	50 MAX. WATTS
PLATE DISSIPATION	1000 MAX. WATTS

TYPICAL OPERATION--Zero Bias--
Cathode Driven

DC Plate Voltage	2500	3000 volts
Zero-Signal DC Plate Current	162	175 mA
Max-Signal DC Plate Current	800	670 mA
Max-Signal DC Grid Current	254	300 mA
Max-Signal Drive Power	30	65 watts
Plate Output Power *	1050	1360 watts
Intermodulation Distortion Products*	-35	— db

*Measured values in operating equipment

AUDIO FREQUENCY AMPLIFIER OR MODULATOR,

Class B

MAXIMUM RATINGS (PER TUBE)	
DC PLATE VOLTAGE	6000 MAX. VOLTS
DC PLATE CURRENT	800 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

*Approximate Value

TYPICAL OPERATION

(Sinusoidal Wave, Two Tubes, Grid Driven)

DC PLATE VOLTAGE	3000	5000 volts
DC GRID VOLTAGE	0	
ZERO SIG DC PLATE CURRENT	300	200 mA
MAX-SIG DC PLATE CURRENT	1450	1000 mA
MAX-SIG DC GRID CURRENT	485	310 mA
DRIVING POWER	48	28 watts
PEAK AF DRIVING VOLTAGE	100	90 volts
LOAD RESISTANCE PLATE TO PLATE	3940	10,200 ohms
MAX-SIG PLATE OUTPUT POWER	2540	3560 watts

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MOUNTING--The 3-1000Z must be operated vertically, base up or base down. A flexible connnecting strap should be provided between the Eimac HR-8 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

▶COOLING--Forced-air cooling is required to maintain the base seals at a temperature below 200° C, and the plate seal at a temperature below 225° C. When using the Eimac SK-510 Air-System Socket and SK-516 Chimney, a minimum air flow rate of 25 cubic feet per minute at a static pressure of approximately 0.43 inch of water, as measured at the socket at sea level, is required to provide adequate cooling at an inlet air temperature of 50° C. Above 30 megacycles the required air flow is increased to 35 cubic feet per minute at a static pressure of approximately 0.8 inch of water, as measured at the SK-510 socket. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-510 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate seal. In all cases, air flow rates in excess of the minimum requirements, will prolong tube life.

FILAMENT OPERATION--The rated filament voltage for the 3-1000Z is 7.5 volts. Filament voltage, as measured at the socket, must be maintained within the range of 7.13 to 7.87 volts to obtain maximum tube life. Operation at reduced voltage decreases emission capability, but increases life expectancy.

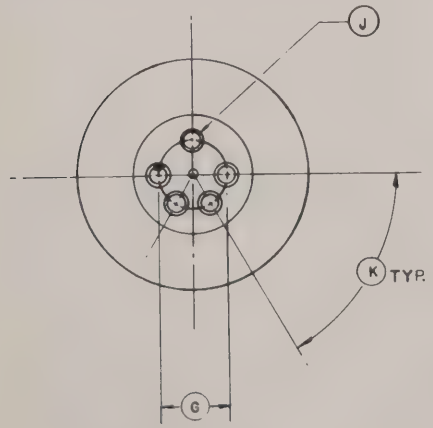
INTERMODULATION DISTORTION--Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megacycles. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better.

CLASS C OPERATION--Although designed for Class B service, the 3-100Z may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristics can be used to advantage in Class C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

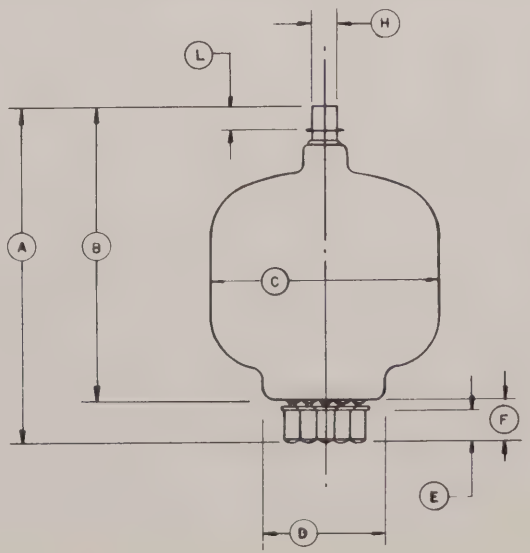
ZERO-BIAS OPERATION--Operating at zero-bias is not recommended with plate voltages over 3000 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias operation as mentioned above under "Class-C Operation" is not available at plate voltages above 3000 volts. Straight Class-C or Class-B operation is, of course, permissible up to 6000 volts where other ratings are not exceeded.

INPUT CIRCUIT--When the 3-1000Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

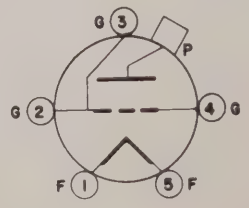
SPECIAL APPLICATIONS--If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



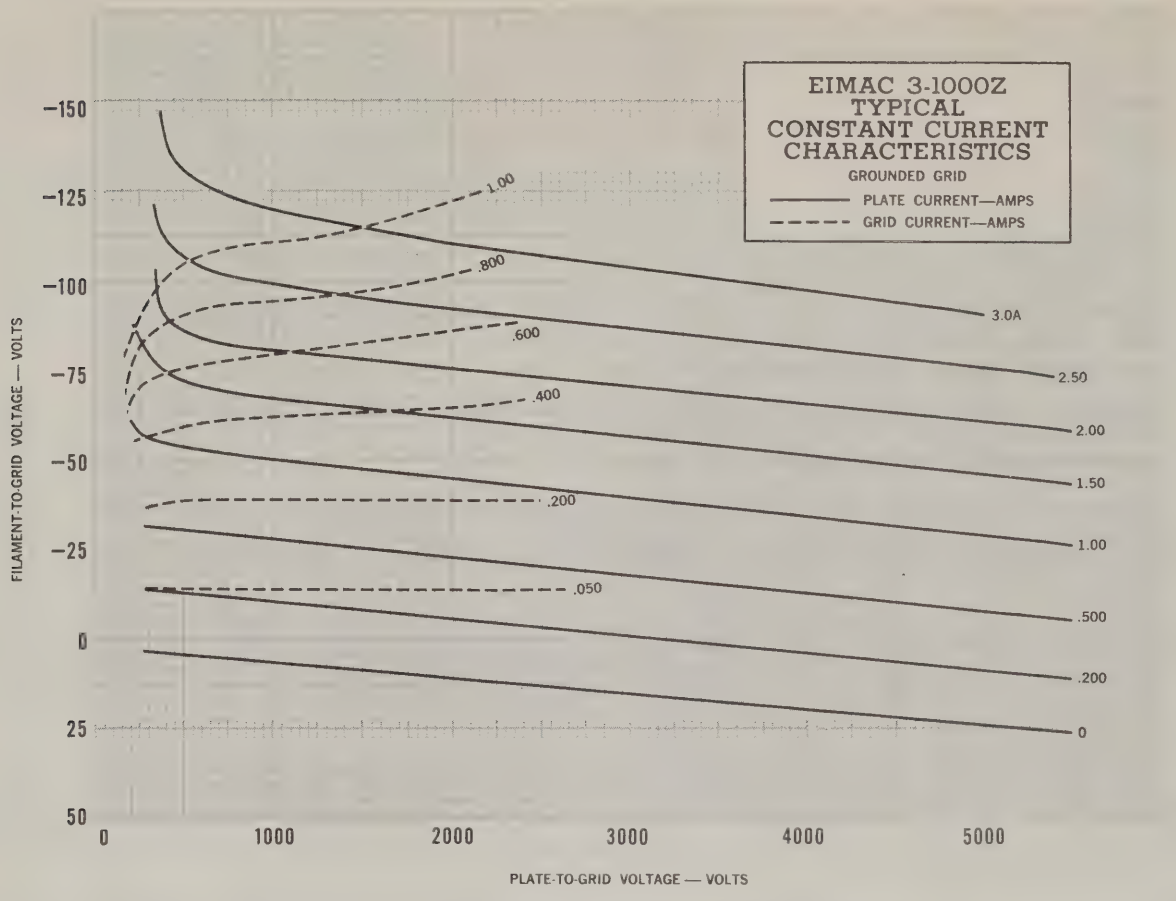
BOTTOM VIEW

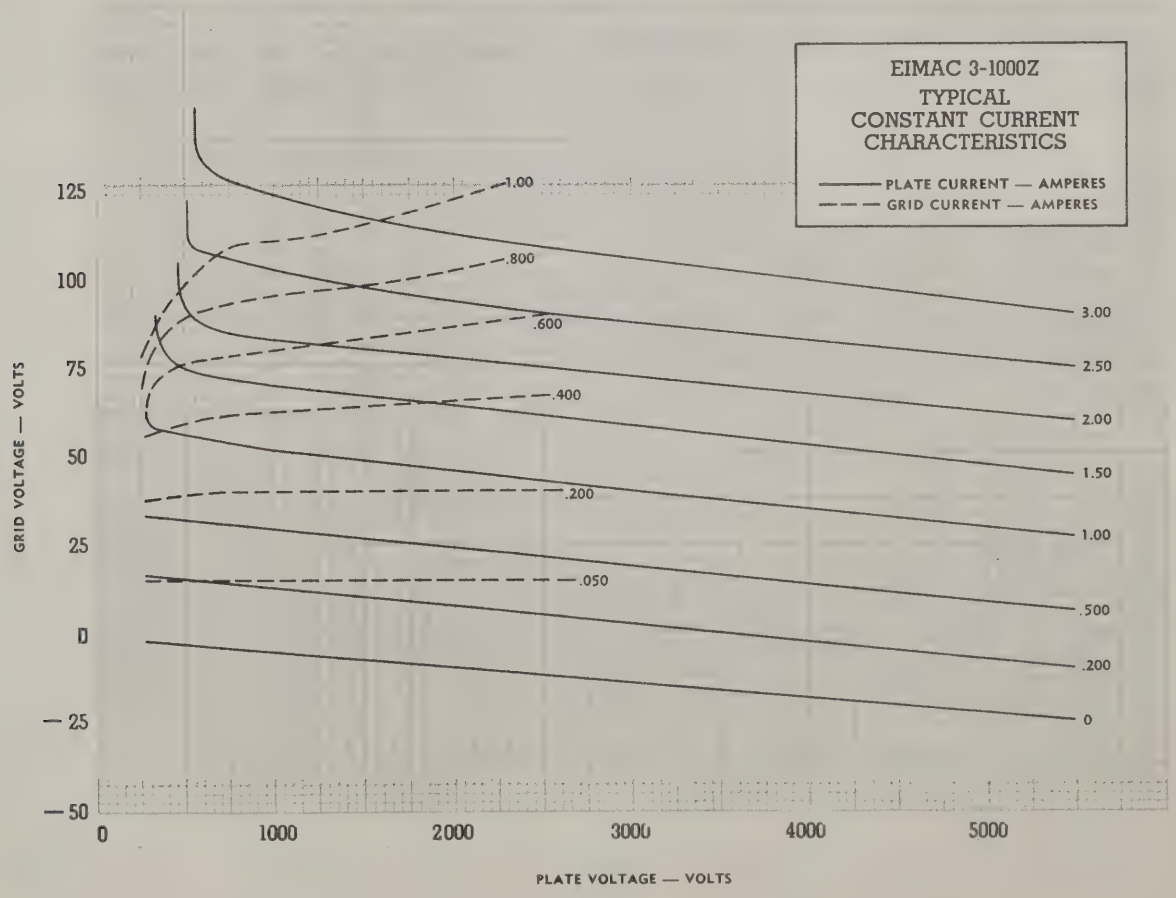


REF	MIN.	NOM.	MAX.
A	7 1/2		7 7/8
B	6 11/16		7 1/16
C			5 1/4
D	2 3/4		2 7/8
E	17/32		21/32
F	25/32		29/32
G		1.500	
H	.559		.573
J	.371		.377
K		60°	
L	.540		.560



▶ Indicates change from sheet dated 3-20-62


EIMAC 3-1000Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT—AMPS
GRID CURRENT—AMPS
FILAMENT-TO-GRID VOLTAGE — VOLTS
−150
−125
−100
−75
−50
−25
0
25
50
0
1000
2000
3000
4000
5000
PLATE-TO-GRID VOLTAGE — VOLTS
1.00
.800
.600
.400
.200
.050
3.0A
2.50
2.00
1.50
1.00
.500
.200
0


EIMAC 3-1000Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
125
100
75
50
25
0
— 25
— 50
0
1000
2000
3000
4000
5000
PLATE VOLTAGE — VOLTS
1.00
.800
.600
.400
.200
.050
3.00
2.50
2.00
1.50
1.00
.500
.200
0

3CX15,000A3

MEDIUM-MU

AIR-COOLED
POWER TRIODE

EITEL-McCULLOUGH, INC.

The Eimac 3CX15,000 A3 is an air-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is rated at 15 kilowatts of plate dissipation.

Full ratings apply up to 100 megacycles. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe application.

It is also recommended as a grounded grid FM amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.
Filament: Thoriated-Tungsten			
Voltage		6.3	volts
Current	152		172 amperes
Amplification Factor		20	
Interelectrode capacitances, Grounded Cathode:			
Grid-Filament	48		58 uuf
Plate-Filament	1.2		1.5 uuf
Grid-Plate	30		38 uuf
Frequency for Maximum Ratings			100 Mc

MECHANICAL

Base	Coaxial
Recommended Socket	Eimac SK-1300
Recommended Chimney	Eimac SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals and Anode Core	250° C
Maximum Dimensions:	
Height	8.5 inches
Diameter	7.0 inches
Net Weight	12 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Industrial

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	8,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
GRID DISSIPATION	500 WATTS
PLATE DISSIPATION	15 KW

TYPICAL OPERATION

DC Plate Voltage	7000 volts
DC Plate Current	6.0 amps
DC Grid Voltage	—600 volts
DC Grid Current	660 mA
Peak RF Grid Voltage	1040 volts
Driving Power	660 watts
Plate Input Power	42 kW
Plate Dissipation	12 kW
Plate Output Power	30 kW
Approximate Load Impedance	-600 ohms

(Effective 4-11-64) © Copyright 1964 by Eitel-McCullough, Inc.

RADIO-FREQUENCY POWER AMPLIFIER PLATE-MODULATED

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	6,500 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	10 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	6000 volts
DC Grid Voltage	550	600 volts
DC Plate Current	2.9	3.9 amps
DC Grid Current	450	520 mA
Driving Power	375	490 watts
Plate Output Power	13.0	18.0 kW

RADIO-FREQUENCY LINEAR AMPLIFIER Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE	8,000 MAX. VOLTS
DC PLATE CURRENT	6.0 MAX. AMPS
PLATE DISSIPATION	15 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Adjust to give specified zero-signal dc plate current.

TYPICAL OPERATION, Class AB_2

DC Plate Voltage	7000 volts
DC Grid Voltage*	−270 volts
Zero-Sig Plate Current	1.5 amps
Max-Sig DC Plate Current	4.8 amps
Max-Sig DC Grid Current	400 mA
Peak RF Grid Voltage	540 volts
Driving Power	215 watts
Plate Output Power	23 kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

FILAMENT—The rated filament voltage for the 3CX15,000A3 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at 6.3 volts plus or minus five percent for long tube life and consistent performance. Maximum life will be obtained by operation at minus 5 percent.

CONTROL GRID OPERATION—The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

PLATE OPERATION—Maximum plate voltage rating of 8000 volts and maximum plate current of 6.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded. When used as a plate modulated rf amplifier, input is reduced to 6500 volts at 5.0 amperes dc.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

HIGH FREQUENCY OPERATION--The 3CX15,-000A3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in class A, B or C service. For plate-modulated applications at 140 Mc, plate voltage is reduced to 5500 volts.

MOUNTING--The 3CX15,000A3 must be mounted vertically, either base up or down.

SOCKET—The Eimac SK-1300 socket is used with the 3CX15,000A3 for making connections to the filament and grid.

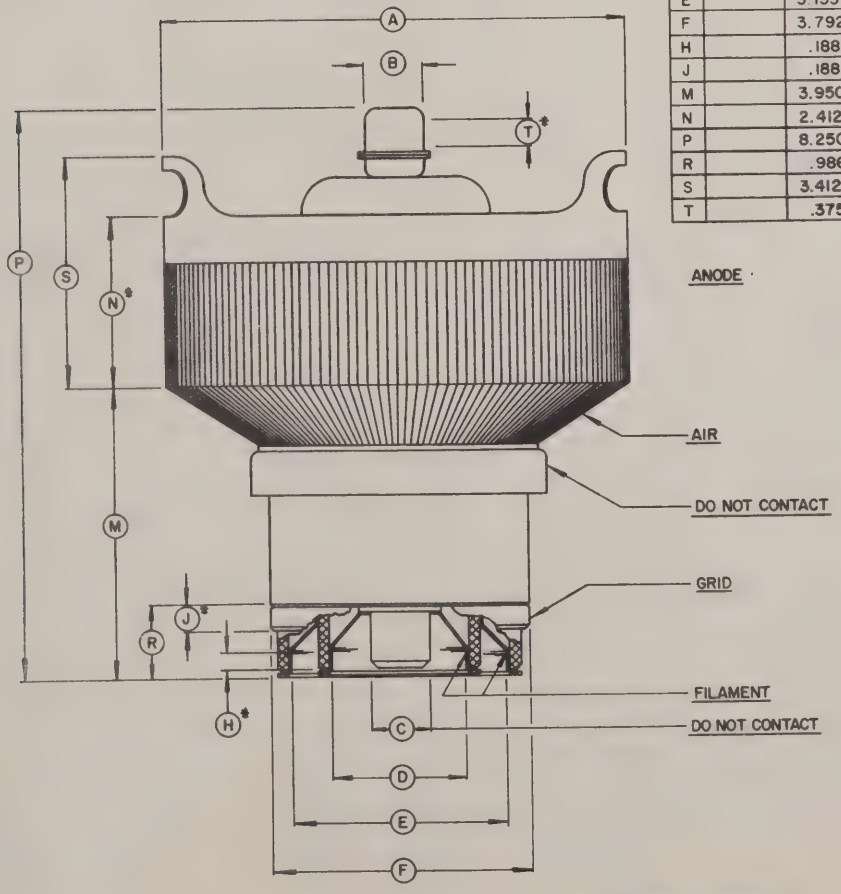
COOLING—Forced-air cooling is required to adequately maintain the rated ceramic-metal seal and anode core temperature of 250° C or below. The table below lists minimum air-flow requirements to maintain tube temperatures at 225° C in 40° C ambient air using the Eimac SK-1300 socket and SK-1306 chimney. Air flow in the base-to-anode direction is recommended; reverse air-flow may be used, but users should contact Eitel-McCullough, Inc. for specific recommendations.

MINUMUM AIR-FLOW REQUIREMENTS (Base-to-Anode Air-Flow)		
*Plate Dissipation (kW)	Air-Flow (CFM)	Pressure Drop (Inches water)
5.0	85	0.2
7.5	195	0.7
10.0	360	2.0
12.5	590	4.9
15.0	970	10.5

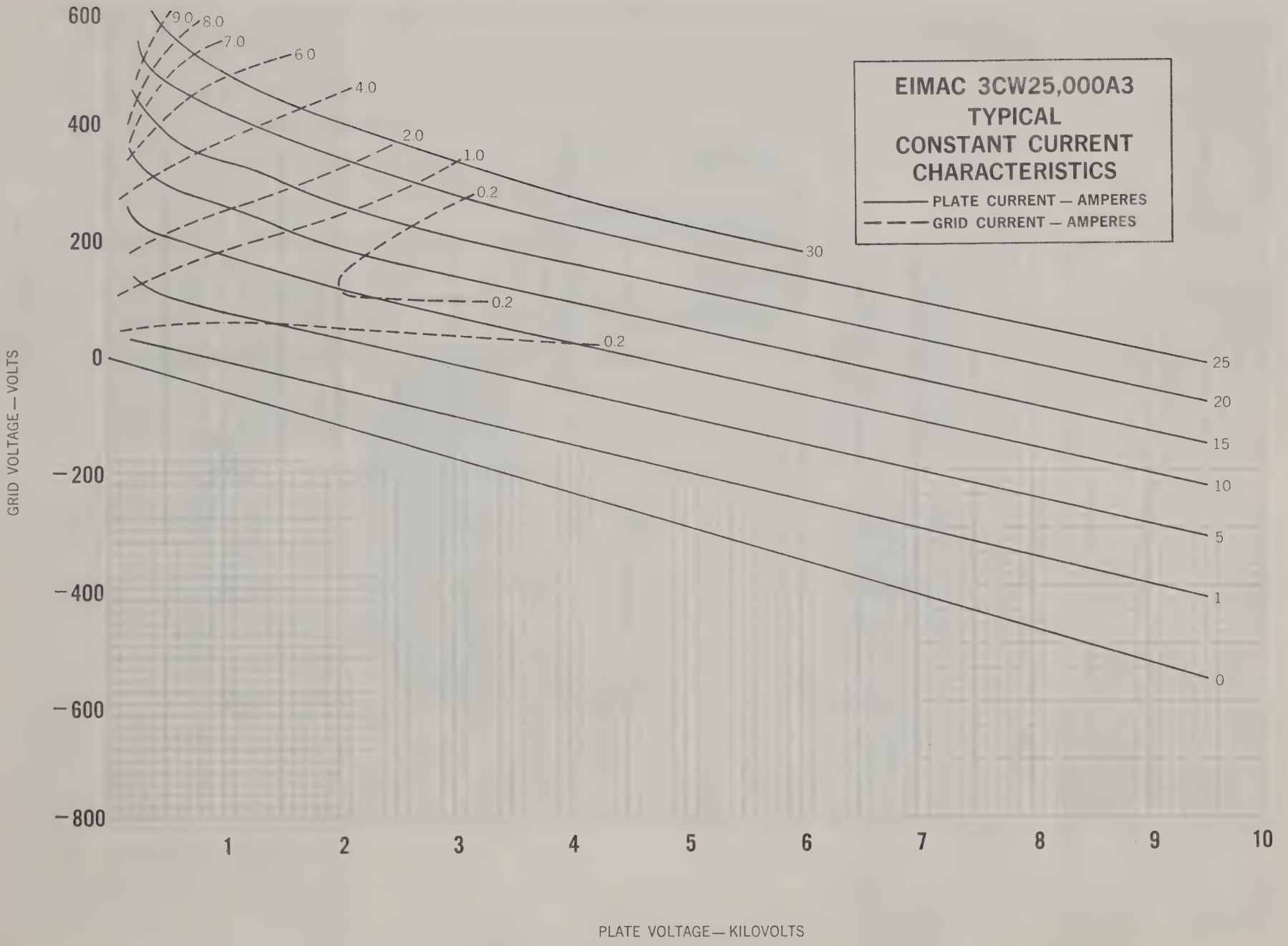
SPECIAL APPLICATION—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.

*An additional 1500 watts has been included in preparing this tabulation to compensate for grid and filament power.

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CW25,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
30
25
20
15
10
5
1
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE — KILOVOLTS

Eimac®

EITEL-McCULLOUGH, INC.

8242
3W5000A3

MEDIUM-MU POWER TRIODE

The Eimac 8242/3W5000A3 is a water-cooled, medium-mu power triode intended for amplier, oscillator or modulator service. It has a maximum plate dissipation rating of 5000 watts and is capable of high output at relatively low plate voltages. A single 3W5000A3 will deliver a radio frequency plate power-output of 7500 watts at a plate voltage of 4000 volts.

NOTE: The 8242/3W5000A3 is a water-cooled version of the air-cooled 8161/3X25000A3.

The 8242/3W5000A3 should be used where water cooling is preferred and for industrial applications or installations where reserve anode dissipation is desired.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage		7.5		volts
Current	49		54	amperes
Amplification Factor (Average)		20		
Direct Interelectrode Capacitances (Average)				
Grid-Plate	17.8		24.2	μμf
Grid-Filament	29.2		40.2	μμf
Plate-Filament	0.60		1.20	μμf
Transconductance (I_b=830 ma, E_b=3000v)		20,000		μmhos
Frequency for Maximum Ratings			75	mc

MECHANICAL

Base	see drawing
Mounting	vertical, base down or up
Maximum Over-All Dimensions:	
Length	12.56 inches
Diameter	3.63 inches
Net Weight	4.8 pounds
Cooling	Water and forced air

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

(Frequencies below 75 Mc.)
Class-C FM or Telegraphy
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	5000 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 75 Mc., per tube)

D C Plate Voltage	4000	5000	6000	volts
D-C Plate Current	2.5	2.5	2.08	amps
D-C Grid Voltage	—300	—450	—500	volts
D-C Grid Current	245	265	180	ma
Peak R-F Grid Input Voltage	580	750	765	volts
Driving Power (approx.)	142	197	136	watts
Grid Dissipation	68	78	46	watts
Plate Power Input	10,000	12,500	12,500	watts
Plate Dissipation	2500	2500	2500	watts
Plate Power Output	7500	10,000	10,000	watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

(Frequencies below 75 Mc.)
Class-C Telephony
(Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	3350 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 75 Mc., per tube)

D C Plate Voltage	4000	4500	5000	volts
D-C Plate Current	1.67	1.55	1.45	amps
Total Bias Voltage	—450	—500	—550	volts
Fixed Bias Voltage	—230	—325	—410	volts
Grid Resistor	1500	1500	1400	ohms
D-C Grid Current	150	120	100	ma
Peak R-F Grid Input Voltage	680	720	760	volts
Driving Power (approx.)	102	86	76	watts
Grid Dissipation	35	26	21	watts
Plate Power Input	6670	6970	7250	watts
Plate Dissipation	1670	1670	1670	watts
Plate Power Output	5000	5300	5580	watts

(Effective 6-1-64) © Copyright 1964 by Eitel-McCullough, Inc., Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D C PLATE VOLTAGE	6000 MAX. VOLTS
MAX-SIGNAL D C PLATE CURRENT, PER TUBE	2.5 MAX. AMPS
PLATE DISSIPATION, PER TUBE	5000 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D C Plate Voltage	4000	5000	6000	volts
D C Grid Voltage[1]	—150	—190	—240	volts
Zero-Signal D C Plate Current	0.6	0.5	0.4	amps
Max-Signal D C Plate Current	4.0	3.2	3.0	amps
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390	volts
Max-Signal Peak Driving Power*	340	230	225	watts
Max-Signal Nominal Driving Power*	170	115	113	watts
Max-Signal Plate Output Power	11,000	11,000	13,000	watts

*Approximate values.

[1]Adjust to give listed zero-signal plate current.

TYPICAL OPERATION CLASS AB_2 (Two Tubes)

Modulator service for 4000 and 5000 volt operation, to modulate one or two tubes, as shown under "Plate Modulated Radio Frequency Amplifier" (Page 1)

D C Plate Voltage	4000	5000	4000	5000	volts
D C Grid Voltage (approx.)*	—155	—200	—145	—190	volts
Zero-Signal D C Plate Current	0.4	0.4	0.6	0.5	amps
Max-Signal D C Plate Current	1.35	1.13	2.70	2.26	amps
Effective Load, Plate to Plate	6600	10,000	3300	5000	ohms
Peak A-F Grid Input Voltage (per tube)	240	275	285	310	volts
Max-Signal Peak Driving Power	42	40	134	118	watts
Max-Signal Nominal Driving Power (approx.)	21	20	67	59	watts
Max-Signal Plate Power Output	3700	4000	7400	8000	watts
Will Modulate one Tube R F Final Input of	6670	7250			watts
Will Modulate two tubes R F Final Input of			13,340	14,500	watts

*Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATON AND RECOMMENDATIONS

APPLICATION

Cooling—Minimum recommended water-flow rate and pressure drop values for different water-inlet temperatures and plate dissipations are tabulated on the opposite page. The outlet water temperature must not exceed a maximum of 70° C under any conditions. The inlet water pressure must not exceed a maximum of 60 pounds per square inch.

The grid-terminal contact surface and adjacent glass must be cooled by forced air. The quantity, velocity and direction must be adjusted to limit the maximum seal temperature to 175° C.

The filament stem structure also requires forced-air cooling. A minimum of 6 cubic feet per minute must be directed into the space between the inner and outer filament contacting surfaces.

Air and water flow must be started before filament power is applied and maintained for at least five minutes after the filament power has been removed.

Filament Voltage—The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

Bias Voltage—There is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage — The plate supply voltage for the 3W5000A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

In Class-C FM or Telegraphy service, a 0.1 henry choke, shunted by a spark gap, should be series connected between the plates of the amplifier tubes and the high voltage plate supply capacitor to offer protection from transients and surges. In plate modulated service, where a plate modulation transformer is used, the protective choke is not normally required.

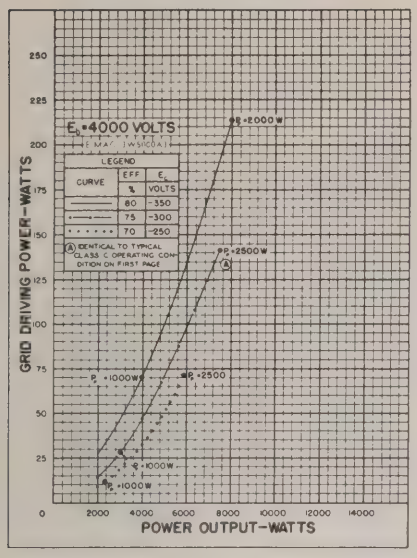
Grid Dissipation—The power dissipated by the grid of the 3W5000A3 must never exceed 150 watts. Grid dissipation may be calculated from the following expression

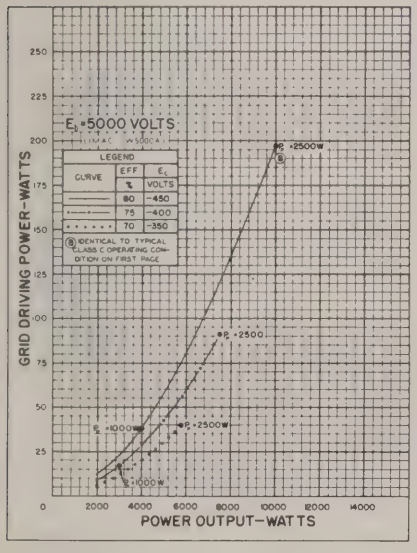
$$P_g = e_{cmp} I_c$$

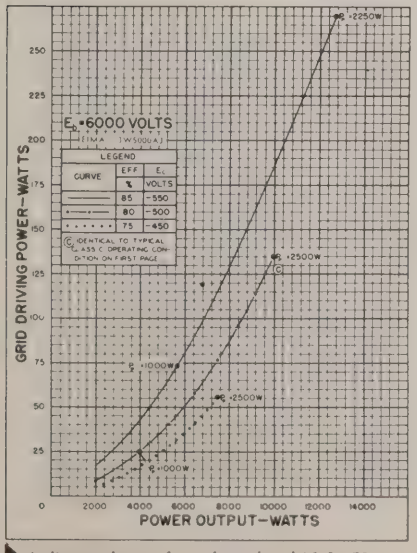
where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-C grid current

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. Any suitable peak v.t.v.m. circuit may be used.

In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.



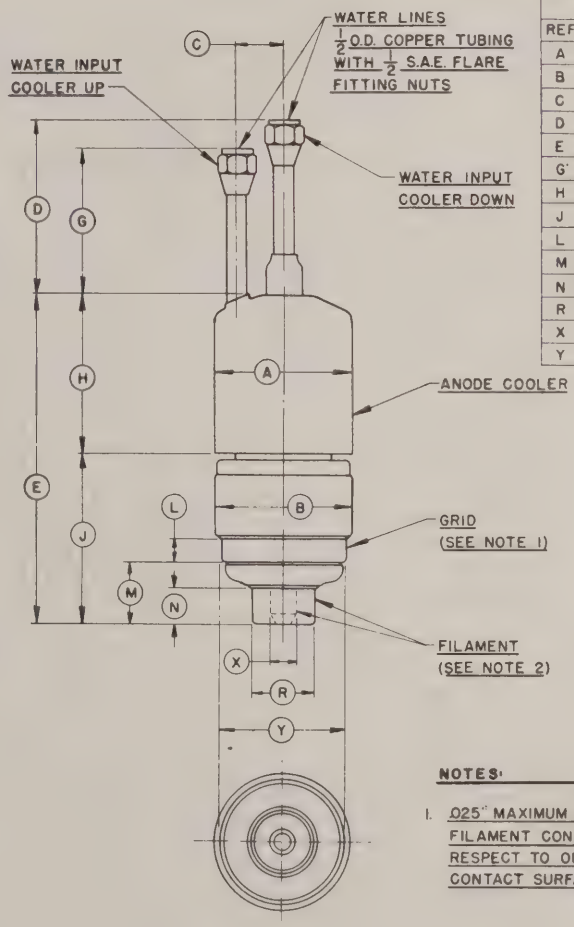




▶ Indicates change from sheet dated 10-21-59

▶ MINIMUM WATER COOLING REQUIREMENTS

Water Inlet Temp. (°C)	Plate Dissipation							
	2 KW		3 KW		4 KW		5 KW	
	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI	Flow Rate GPM	Pressure Drop PSI
20	1.7	0.68	2.6	1.3	3.9	2.3	5.6	3.9
30	2.3	1.1	3.2	1.7	4.5	2.8	6.2	4.5
40	3.0	1.6	3.8	2.2	5.3	3.5	6.9	5.3
50	3.9	2.3	4.7	3.0	6.0	4.3	7.7	6.1



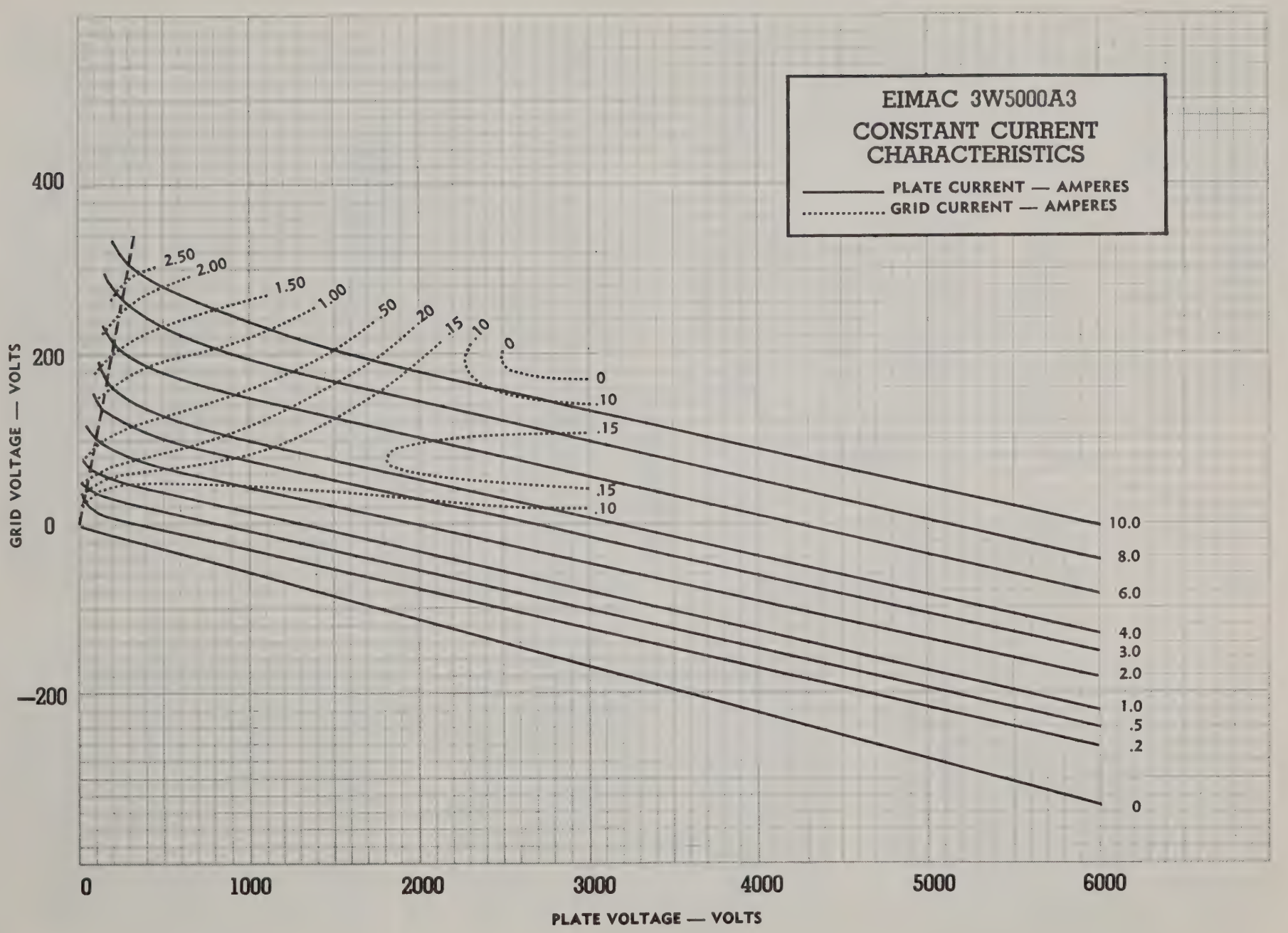
DIMENSION DATA			
REF.	NOM.	MIN	MAX.
A		3.234	3.266
B			3.625
C		1.062	1.187
D		4.000	4.500
E		7.562	8.062
G		3.250	3.750
H		3.625	3.875
J		3.937	4.187
L		.375	.437
M		1.437	1.562
N		.812	.937
R		1.490	1.510
X		.615	.635
Y		2.990	3.010

NOTES:

1. .025" MAXIMUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3W5000A3
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
400
200
0
—200
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
0
.10
.15
.15
.10
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS

8251
3X2500F3

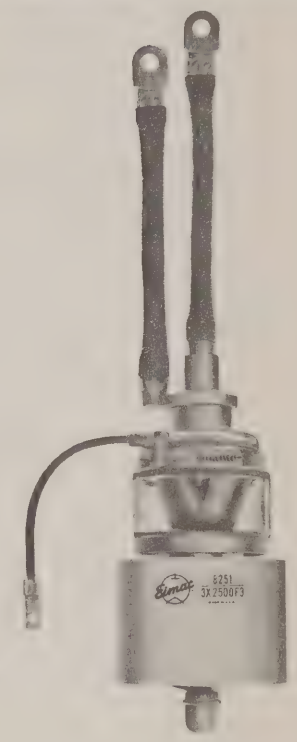
MEDIUM-MU

TRIODE

The Eimac 8251/3X2500F3 is a medium-mu, forced-air cooled, external-anode power triode intended for amplifier, oscillator, or modulator service. It has a maximum plate-dissipation rating of 2500 watts and is capable of high output at relatively low plate voltages. A single 8251/3X2500F3 will deliver a radio-frequency plate power output of 7500 watts at a plate voltage of 4000 volts.

The tube is equipped with flexible filament and grid leads which simplify socketing and equipment design for industrial and communication frequencies below 30 megacycles.

The approved Federal Communications Commission rating for the 8251/3X2500F3 is 5000 watts of carrier power when used as a plate-modulated amplifier and 1250 watts of carrier power when used as a grid-modulated or linear amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	48		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances:				
Grid-Plate	16.8		23.2	uuf
Grid-Filament	29.2		40.2	uuf
Plate-Filament	0.6		1.2	uuf
Transconductance (I_b=830 ma., E_b=3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			30	mc

MECHANICAL

Base	See outline drawing
Mounting	Vertical, base down or up
Maximum Anode Cooler Core and Seal Temperatures	175° C
Cooling	Forced air
Maximum Over-All Dimensions:	
Length (Does not include filament connectors)	8.6 inches
Diameter	4.16 inches
Length of Filament Connectors (Approximate)	9.5 inches
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier,
Class-C FM or Telegraphy (Key-Down Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	5000	6000 volts
D-C Plate Current	2.5	2.5	2.08 amps
D-C Grid Voltage	—300	—450	—500 volts
D-C Grid Current	245	265	180 ma
Peak R-F Grid Input Voltage*	580	750	765 volts
Driving Power*	142	197	136 watts
Grid Dissipation*	68	78	46 watts
Plate Input Power	10,000	12,500	12,500 watts
Plate Dissipation	2500	2500	2500 watts
Plate Output Power	7500	10,000	10,000 watts

*Approximate values.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier,
Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5500 MAX. VOLTS
D-C PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	1670 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc)

D-C Plate Voltage	4000	4500	5000 volts
D-C Plate Current	1.67	1.47	1.25 amps
D-C Grid Voltage	—450	—500	—550 volts
D-C Grid Current*	180	140	150 ma
Peak R-F Grid Input Voltage*	685	715	760 volts
Driving Power*	125	100	115 watts
Grid Dissipation*	43	30	32 watts
Plate Input Power	6670	6615	6250 watts
Plate Dissipation	1670	1315	950 watts
Plate Output Power	5000	5300	5300 watts

*Approximate values.

(Effective 6-30-64) Copyright 1964 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 12-5-62

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION	2500 MAX. WATTS
GRID DISSIPATION	150 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	4000	5000	6000 volts
D-C Grid Voltage[1]	—150	—190	—240 volts
Zero-Signal D-C Plate Current	0.6	0.5	0.4 amps
Max-Signal D-C Plate Current	4.0	3.2	3.0 amps
Effective Load, Plate to Plate	2200	3600	4650 ohms
Peak A-F Grid Input Voltage (per tube)*	340	360	390 volts
Max-Signal Peak Driving Power*	340	230	225 watts
Max-Signal Nominal Driving Power*	170	115	113 watts
Max-Signal Plate Output Power	11,000	11,000	13,000 watts

*Approximate values.

[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

Cooling—Forced-air cooling must be provided to hold the glass-to-metal seals and the anode cooler core below the maximum rated temperature of 175° C. Although the air requirements stated below are sufficient to maintain rated tube temperatures under many conditions, air in excess of the amounts shown will usually result in longer tube life, At ambient temperatures higher than 20° C and at high altitudes additional air flow must be provided. In all cases, tube temperatures are the criteria which govern air requirements. Surface temperatures may be measured conveniently with the aid of temperature-sensitive paints.

Anode-to-Base Air-Flow				
	Sea Level		10,000 Feet	
Plate Dissipation (Watts)	Air-Flow (CFM)	Pressure Drop (Inches H_2O)	Air-Flow (CFM)	Pressure Drop (Inches H_2O)
2000	58.5	0.8	85.5	1.15
2500	85.5	1.6	125	2.3

Base-to-Anode Air-Flow				
	Sea Level		10,000 Feet	
Plate Dissipation (Watts)	Air-Flow (CFM)	Pressure Drop (Inches H_2O)	Air-Flow (CFM)	Pressure Drop (Inches H_2O)
2000	35.5	0.25	52	0.35
2500	42	0.5	61.5	0.75

Under the same conditions, a minimum air-flow rate of 6 CFM directed into the filament-stem structure betv een the inner and outer filament terminals is required to maintain the base seals below 175° C.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is not recommended as a standard operating practice.

Filament Voltage—The filament voltage as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts. Tube life may be extended by operation at the lower end of this range.

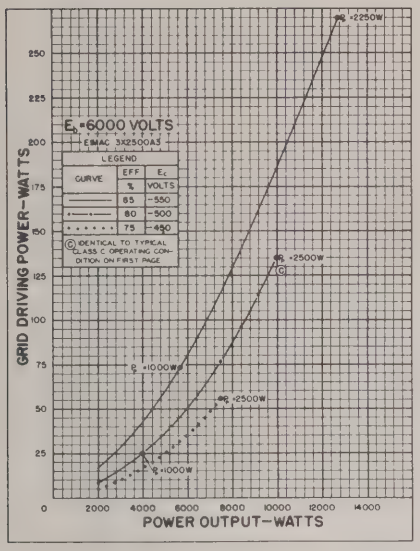
Bias Voltage—There is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

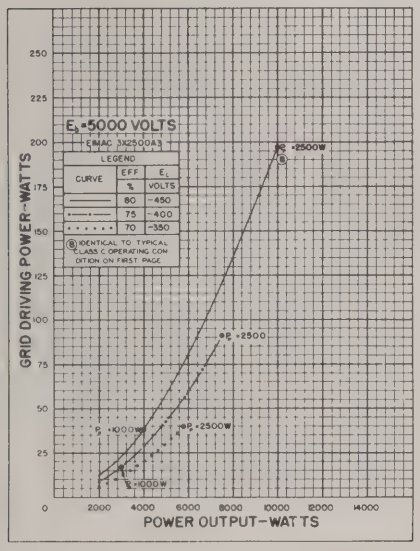
Plate Voltage — The plate-supply voltage for the 3X2500F3 should not exceed 6000 volts.

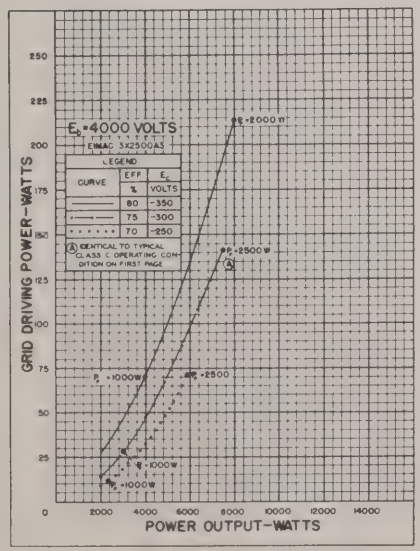
In Class-C FM or Telegraphy service, a 0.1-henry choke, shunted by a spark gap, should be series connected between the plates of the amplifier tubes and the high-voltage plate-supply capacitor to offer protection from transients and surges. In plate-modulated service, where a plate-modulation transformer is used, the protective choke is not normally required.

Grid Dissipation—The power dissipated by the grid of the 3X2500F3 must never exceed 150 watts. Grid dissipation is the product of dc grid current and peak positive grid voltage.

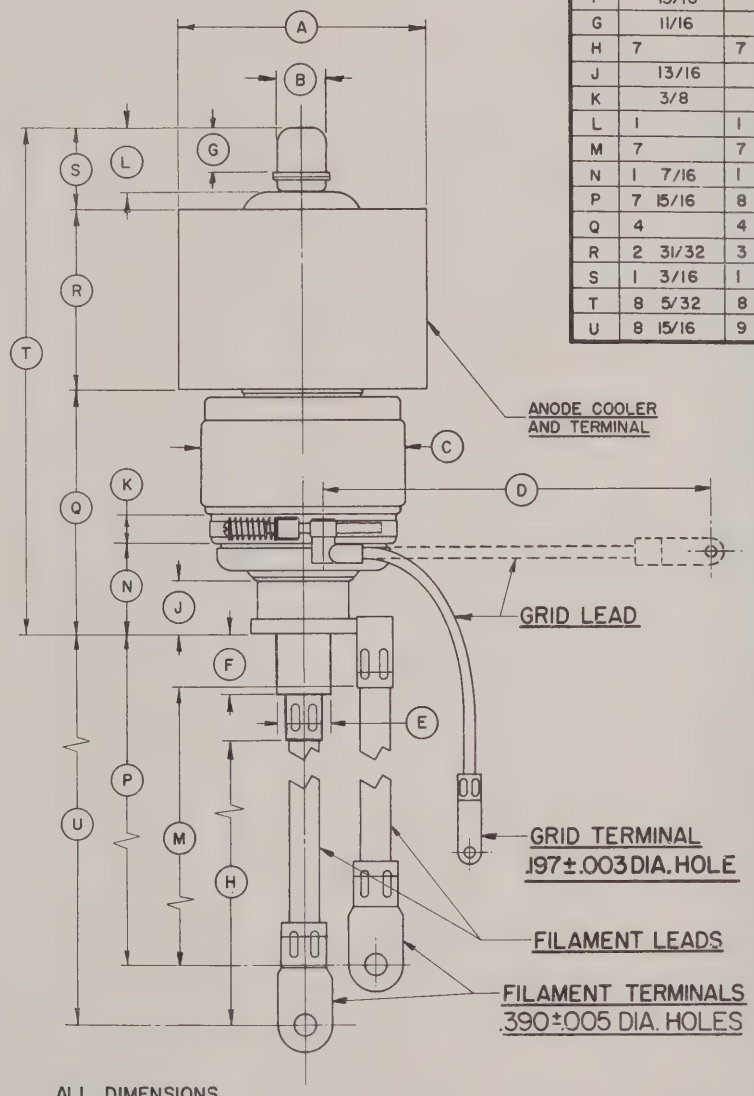
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





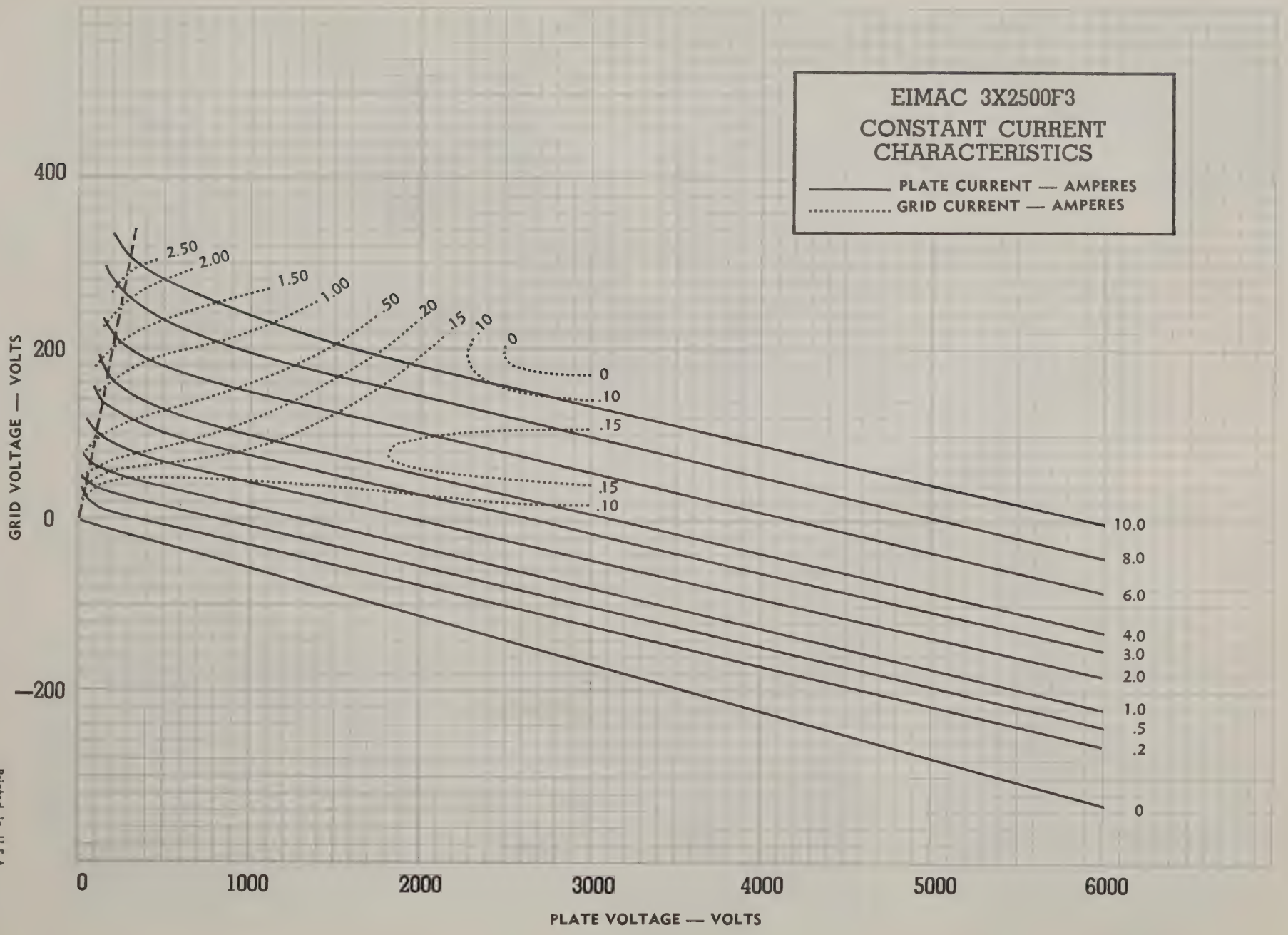


DIMENSION DATA		
REF.	MIN	MAX
A	4 3/32	4 5/32
B	25/32	27/32
C		3 5/8
D	6 3/8	6 5/8
E	55/64	57/64
F	13/16	15/16
G	11/16	13/16
H	7	7 1/2
J	13/16	15/16
K	3/8	7/16
L	1	1 1/8
M	7	7 1/2
N	1 7/16	1 9/16
P	7 15/16	8 7/16
Q	4	4 1/8
R	2 31/32	3 1/32
S	1 3/16	1 7/16
T	8 5/32	8 19/32
U	8 15/16	9 7/16



ALL DIMENSIONS IN INCHES

▶ Indicates change from sheet dated 1-27-58



Printed in U.S.A.

EITEL-McCULLOUGH, INC.

WL-120
WL-130
WL-140

WATER LOADS

Eimac WL-120, WL-130 and WL-140 are 3-1/8" coaxial water loads covering the frequency range of 200 to 1200 megacycles. These loads will dissipate up to 50 kilowatts average power and three megawatts peak power.

Each of these loads is equipped with a sampling loop which provides a convenient rf monitoring source. Measurement of rf power by calorimetric methods* can be accomplished through the use of auxiliary temperature and flow measuring devices. Thermometer wells are available as accessories.

Because the rf power is dissipated directly into the fluid in these loads the resistivity of the fluid affects the VSWR which the loads present. Fluids having specific resistances of 5000 ohm centimeters or less produce excellent results. Tap water and 50% to 60% solutions of ethylene glycol and distilled water are ordinarily acceptable. Because the resistivity of the fluid changes with temperature the outlet temperature should be kept as low as possible.

These loads can be furnished equipped to withstand pressurization if required. The peak power ratings listed in this data sheet are with pressurization. If pressurization is employed provision must be made to prevent application of gas pressure without adequate fluid pressure. The gas pressure must not exceed the fluid pressure by more than 5 psi.

*When the fluid is water the power formula is:

Power (kw) = 0.264 x Flow-rate (gpm) x Temperature Rise (°C)

Typical values of the constant in this formula for the 60% ethylene glycol solution are: 0.208 at 15° C, 0.215 at 40° C, and 0.226 at 70° C.



(Effective 6-1-64) © Copyright 1964 by Eitel-McCullough, Inc.

CHARACTERISTICS

ELECTRICAL

	WL-120	WL-130	WL-140	
Frequency Range (Inlet Water Temperature 25° C, VSWR<1.2:1)	500-1200	320-1200	200-1200	megacycles
Frequency Range (Inlet Water Temperature 60°C, VSWR<1.2:1)	800-1200	600-1200	400-1200	megacycles
Average Power	50	50	50	kilowatts
Peak Power	3	3	3	megawatts
Impedance	50	50	50	ohms

Coupling (rf): EIA Standard RS-225

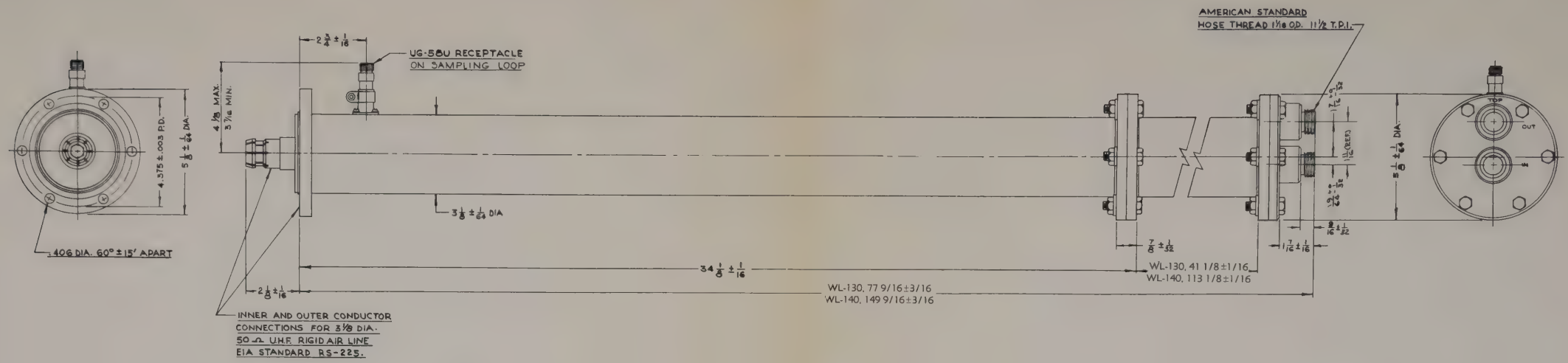
MECHANICAL

Operating Position: Horizontal or rf connection down

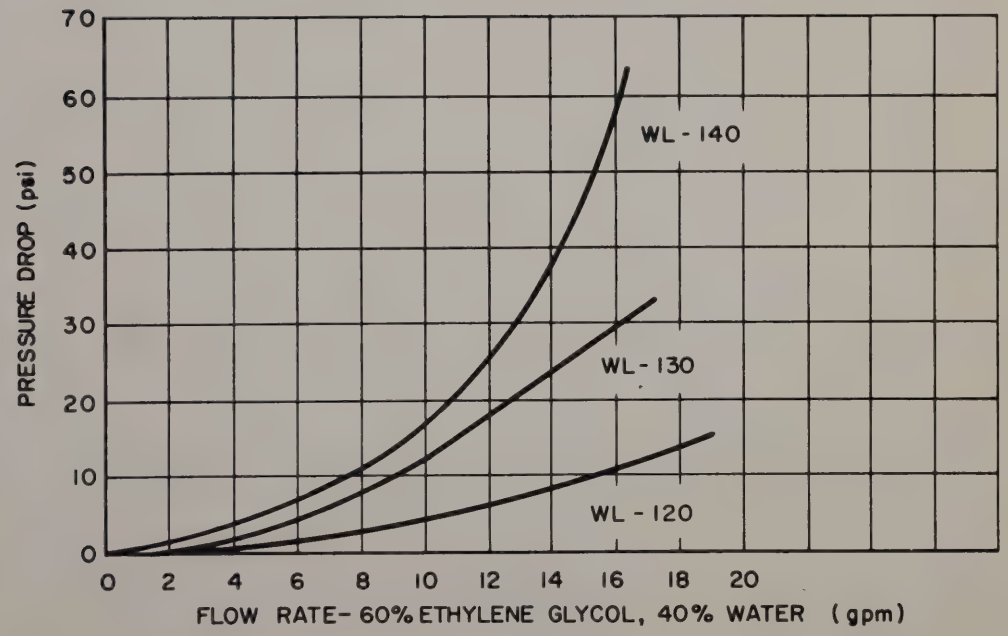
Length	38	80	152	inches
Weight (Empty)	13-1/2	25	38-1/2	pounds
Water Capacity	0.43	1.72	3.96	gallons
Maximum Static Water Pressure	90	90	90	psig
Maximum Outlet Water Temperature	70	70	70	degrees C
Maximum Gas Pressure relative to water pressure	5	5	5	psi

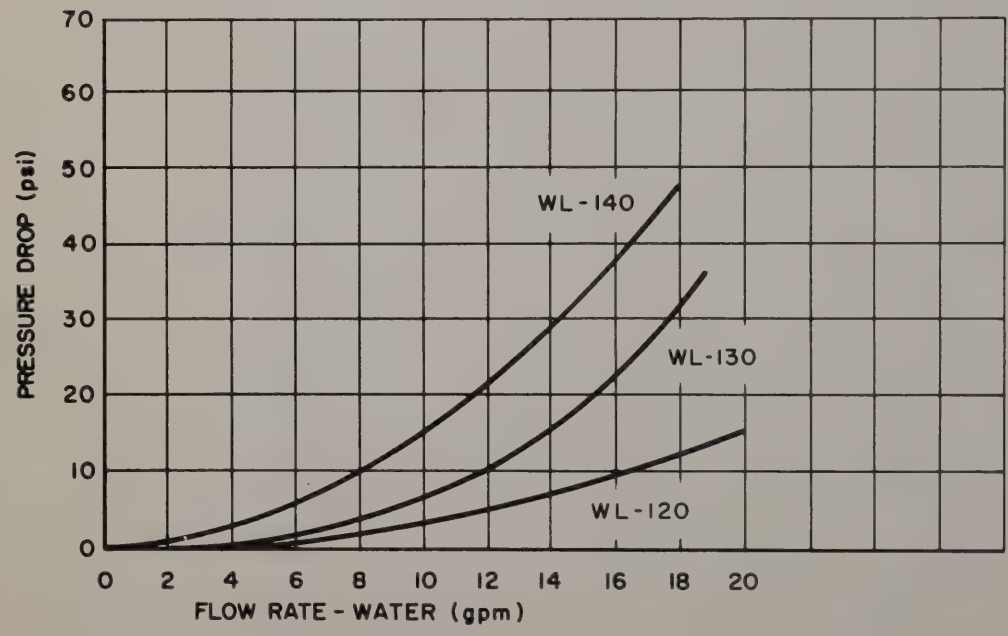
Water Connections: American Standard Hose thread, 1-1/6" O.D., 11-1/2 T.P.I.

For additional information or information regarding a specific application, write to Eitel-McCullough, San Carlos, California.



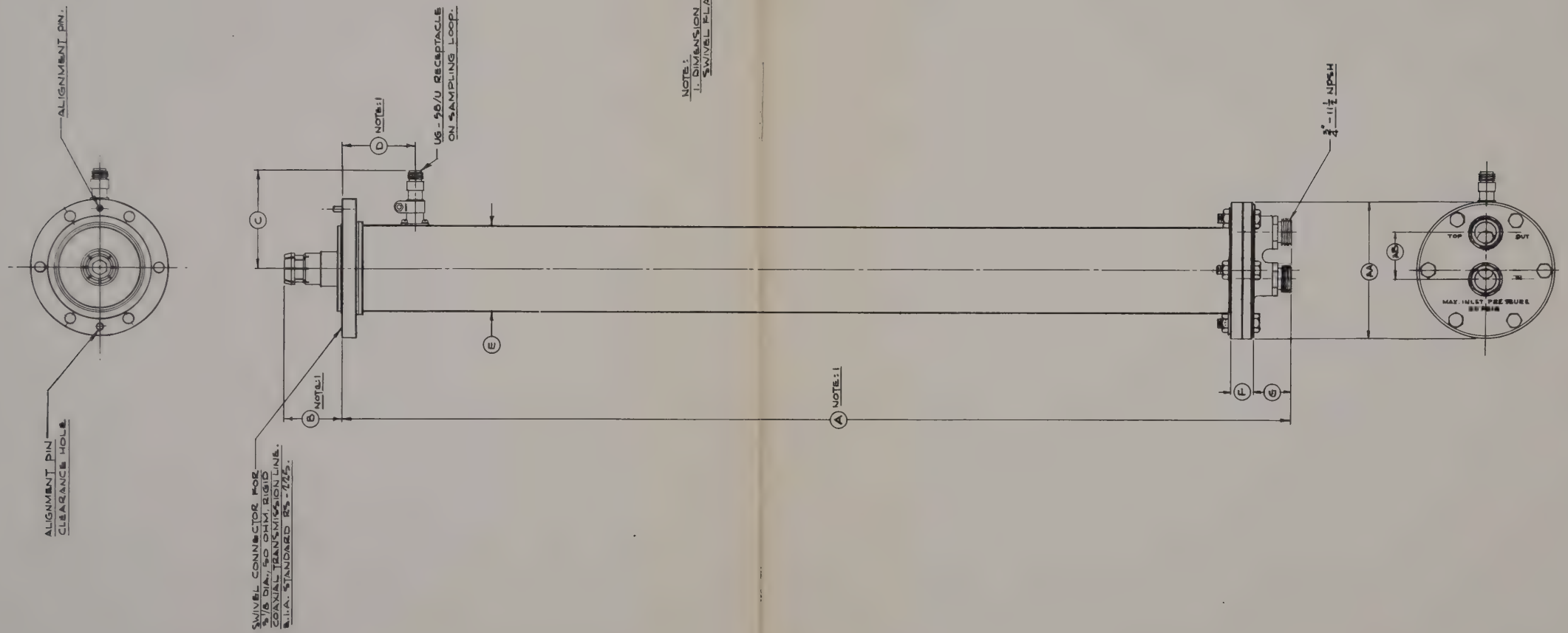
WL-130 & WL-140 OUTLINE





WL-120, WL-130, WL-140

DIMENSIONAL DATA			
REF	NOM.	MIN.	MAX.
A		95.437	95.688
B		1.062	2.188
C		3.438	4.125
D		2.687	2.813
E		3.109	3.141
F		.781	.844
G		1.400	1.600
AA		5.094	5.156
AB		1.687	1.813



WL-120 OUTLINE

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

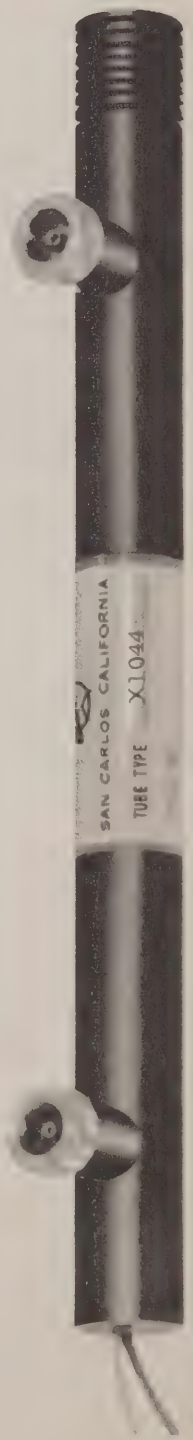
X-1044

TRAVELING WAVE TUBE

5.0 - 11.0 Gc
2 Watt Min.
60 db Small Signal Gain

DESCRIPTION

To satisfy the need for a lightweight, highly efficient Traveling Wave Tube for use as a dependable amplifier in rocket and missile systems, Eimac offers the X-1044. The same rugged features of the Eimac EM-778 TWT which have proven exceptionally reliable in airborne applications for years are now available in this miniaturized tube design. The X-1044 has the full advantage of ceramic and metal construction and is focussed by a periodic permanent magnet array which requires no compensation for operation at extreme temperatures. Models are available with collector depression for applications requiring unusually high efficiency.



ELECTRICAL SPECIFICATIONS: [1]

Absolute Ratings	Maximum	Minimum
Filament Voltage	6.6	6.0 V
Filament Current	0.4	0.3 A
Helix Voltage [2]	1800	— Vdc
Helix Current	4.0	— mAdc
Beam Power Input	37	— W
Collector Temperature	100	— °C
Cathode Warm-Up	—	30 Sec.

Operating and Performance Data

Filament Voltage [3]	6.3 V
Filament Current	0.3 Vdc
Helix Current	2.0 mAdc
Helix Voltage	1650 Vdc
Cathode Current	20 mAdc
Focus Electrode Voltage	0 Vdc
Focus Electrode Current	0 mAdc
Duty Cycle	CW
Frequency Range	5.0-11.0 Gc
Small Signal Gain - Minimum	60 db
- Typical	65 db
Saturated Power Out - Minimum	2 W
- Typical	3 W
Output VSWR (Cold), Maximum	2:1
Input VSWR (Cold), Maximum	2:1
Input and Output Impedance	50 ohms

ENVIRONMENTAL SPECIFICATIONS:

Vibration	10 g to 2000 cps (Curve A of Proc XII, MIL-E-5272C)
Shock	25 g, 11 ±1 ms
Acceleration	25 g, Sustained
Temperature	−54 °C to ±85 °C
Altitude	70,000 ft

Effective 6-20-64 © Copyright 1964 by Eitel-McCullough, Inc.,

Printed in USA.

MECHANICAL SPECIFICATIONS:

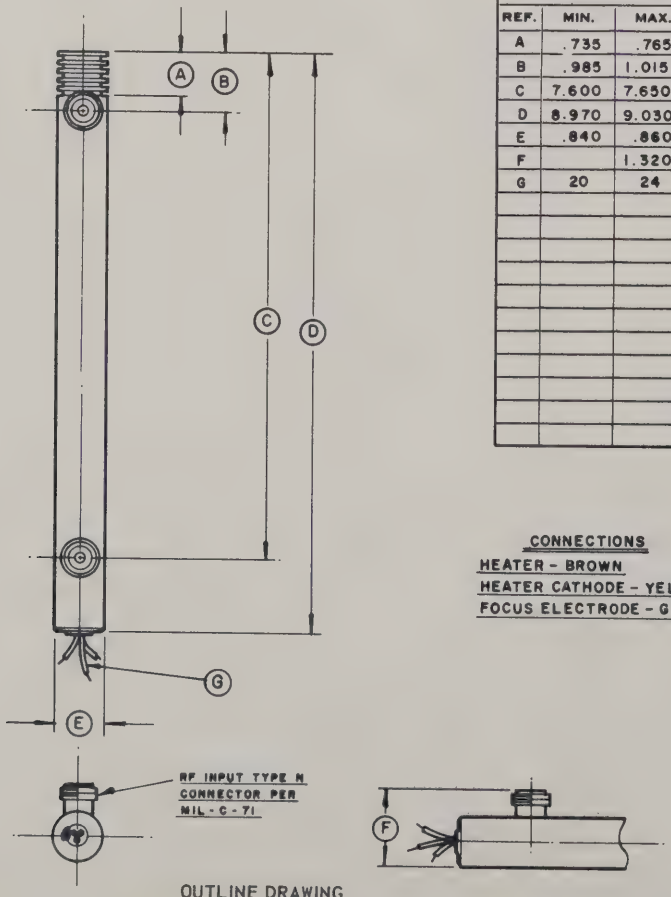
Operating Position - Any
Couplings, rf - - - Type N Coaxial Female Connectors
Focusing - - - - PPM
Cooling [4] - - - - Conduction or Forced Air
Dimensions - - - See Outline Drawing
Weight - - - - - 1 lb.
H. V. Leads - - - Flying

NOTES

1. ALL VOLTAGES ARE REFERENCED TO THE CATHODE.
2. The HELIX is normally grounded but models are available to allow serrodyne operation. Furthermore, HELIX and FOCUS ELECTRODE voltages can be adjusted to optimize performance in discrete frequency bands.
3. The FILAMENT voltage should be maintained to within −5% of the rated value if variations in performance are to be minimized and longest life obtained.
4. The tube is designed to be cooled by conduction through the mounting structure. Under environmental conditions normally encountered in military applications, additional cooling is not required.

THESE DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	.735	.765	
B	.985	1.015	
C	7.600	7.650	
D	8.970	9.030	
E	.840	.860	
F		1.320	
G	20	24	LEAD LENGTH



CONNECTIONS
HEATER - BROWN
HEATER CATHODE - YELLOW
FOCUS ELECTRODE - GREEN

OUTLINE DRAWING

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

X1059

TRAVELING WAVE TUBE
4.0-8.0 Gc
2 WATT MIN.
38 db SMALL SIGNAL GAIN

TENTATIVE DATA SHEET TRAVELING WAVE TUBE X1059

DESCRIPTION

The X1059 is a ruggedized, C-Band, octave bandwidth Travleing Wave Tube with metal-ceramic construction capable of operation under severe environments. Focusing is accomplished by a fully temperature compensated magnet array. This tube may be used in serrodyning applications.

ELECTRICAL SPECIFICATIONS:

Absolute Ratings	Maximum	Minimum
Filament Voltage	6.7	5.9 V
Filament Current	1.5	- A
Helix Current	7.0	- mAdc
Helix Voltage	+2600	- Vdc
Cathode Current	30.0	- mAdc
Control Grid Voltage	−150	0 Vdc
Anode Voltage	+200	0 Vdc
Anode Current	0.250	- mAdc
Duty Cycle	CW	
Beam Power Output	78	- W
Input Power, rf	20	- dbm
Power Reflected From Load	5	- W
Temperature, Body	+175	° C
Temperature, Collector	+175	° C
Ambient Temperature	+120	−54° C
Cathode Warm-Up	-	60 Seconds
Altitude	70,000	- ft

Operating and Performance Data	
Filament Voltage	6.3 V
Filament Current	0.9 A
Helix Voltage	+2500 Vdc
Cathode Current	30 mAdc
Control Grid Voltage	0 Vdc
Control Grid Current	0 mAdc
Anode Voltage	0 to 200 Vdc
Anode Current	0.250 mAdc
Serrodyne Voltage	105-115 Vdc
Duty Cycle	CW
Frequency Range	4.0-8.0 Gc
Small Signal Gain --Minimum	33 db
--Typical	38 db
Saturated Power Out--Minimum	2 W
--Typical	3 W
Output VSWR (Cold)	2.5:1
Input VSWR (Cold)	2.0:1
Input and Output Impedance	50 ohms

Effective 3-4-64 © Copyright 1964 by Eitel-McCullough, Inc. Printed in U.S.A.

ENVIRONMENTAL SPECIFICATIONS:

The X1059 conforms to MIL-E-5400

Vibration	10 g's to 2000 cps
Shock	15 g's (11 ± 1 msec)
Temperature	−54°C to +120°C
Altitude	70,000 Ft.

MECHANICAL SPECIFICATIONS:

Operating Position	Any
Input Coupling, rf	Type TNC Coaxial Fitting
Output Coupling, rf	Type TNC Coaxial Fitting
Focusing	PPM
Cooling	Passive Heat Sink
Dimensions	See Outline Drawing
Weight	4 Pounds
H. V. Leads	#22 AWG Teflon Ins. Flying Leads

APPLICATION NOTES:

ALL VOLTAGES ARE WITH RESPECT TO CATHODE.

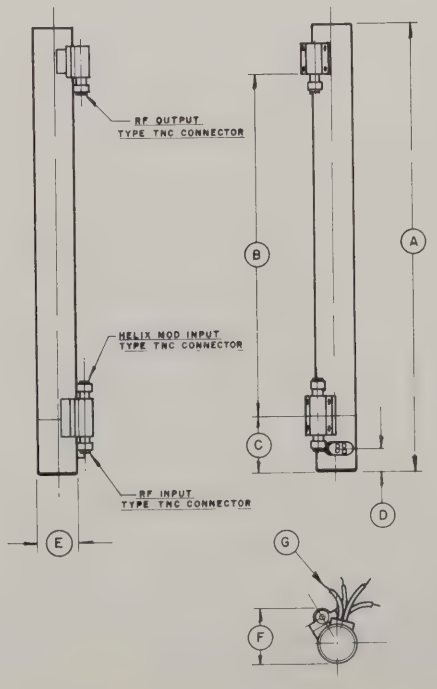
COOLING: The X1059 is designed to be heat sink cooled. Under environmental conditions normally encountered in military equipments, additional cooling is not required.

FILAMENT: The heater voltage should be maintained within ±5% of the rated value of 6.3 volts if variations of performance are to be minimized and best tube life obtained.

CONTROL GRID: The control grid is a high mu control electrode. Normal operation is obtained at zero volts, eliminating the need for an additional control power supply. However, in pulse applications the grid may be used to gate the tube on and off.

SERRODYNE: The helix is isolated from the tube body allowing serrodyne operation for frequency translation applications. The cathode voltage should be maintained within ±1% to insure rated performance.

THIS DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN.



DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	13.940	14.060	
B	10.625	10.875	
C	1.690	2.810	
D	.630	.870	
E	1.230	1.270	
F		1.700	
G	24"	26"	LEAD LENGTH

CONNECTIONS

1. HEATER - BROWN
2. HEATER CATHODE - YELLOW
3. GRID - GREEN
4. ANODE - BLUE

Eimac

EITEL-McCULLOUGH, INC.

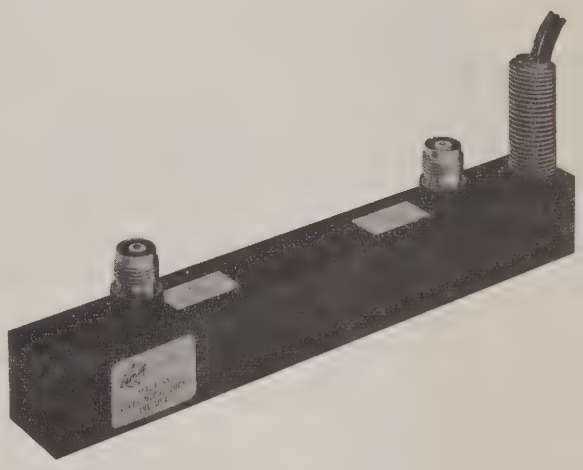
X1131

TRAVELING WAVE TUBE

7.0 - 8.0 Gc
3.0 WATTS
36 db GAIN

TENTATIVE DATA SHEET TRAVELING WAVE TUBE X1131

The X1131 is a highly reliable light weight miniaturized Traveling Wave Tube Amplifier designed for long life in space applications. The tube is of metal-ceramic construction utilizing periodic permanent magnets as the focusing array. From 7.0 to 8.0 Gc, 2.5 Watts of rf power at 36 db gain is provided. Electronic efficiency with collector depression is typically 33%.



ELECTRICAL SPECIFICATIONS:

Absolute Ratings	Maximum	Minimum
Filament Voltage	10	- volts
Filament Current	0.30	- Ampere
Helix Voltage	1600	1200 Vdc
Body and Helix Current	1.0	- mAdc
Collector Voltage	1600	550 Vdc
Collector Current	16	- mAdc
Focus Electrode Voltage	−100	- Vdc
Focus Electrode Current	1.0	- mAdc
Anode Voltage	1800	1650 Vdc
Anode Current	0.2	- mAdc
Duty Cycle	100	- %
Beam Power Input	25	- W
Input Power, rf	100	- mW
Power Reflected From Load	3.0	- W
Temperature, Body	+100	-60° C
Temperature, Collector	+200	-60° C
Ambient Temperature	+100	-50° C
Cathode Warm-Up	-	120 Seconds

Operating and Performance Data	
Filament Voltage	6.3 Volts
Filament Current	0.20 A
Helix Voltage	1450 Vdc
Body and Helix Current	0.50 mAdc
Collector Voltage	575 Vdc
Collector Current	14.5 mAdc
Focus Electrode Voltage	0 Vdc
Focus Electrode Current	0 mAdc
Anode Voltage	1550 Vdc
Anode Current	0.2 mAdc
Duty Cycle	100 %
Frequency Range	7.0-8.0 Gc
Small Signal Gain-Minimum	40 db
-Typical	43 db
Saturated Power Out-Minimum	2.5 W
-Typical	3.0 W
Saturated Gain-Minimum	36 db
-Typical	38 db
Output VSWR (Cold)	1.5:1
Input VSWR (Cold)	1.5:1
Input and Output Impedance	50 ohms
Noise Figure, Typical	28 db

Effective 3-17-64 © Copyright 1964 by Eitel-McCullough, Inc., Printed in U.S.A.

ENVIRONMENTAL SPECIFICATIONS:

Applicable military specifications:	MIL-E- 5400 MIL-E- 5272
Vibration - - - - - -	20 g's at 5000 cps
Shock - - - - - - -	100 g's
Acceleration - - - - -	20 g's
Temperature - - - - -	—50° C to +100° C

Altitude--Any, when used in conjunction with hermetically sealed capsule

MECHANICAL SPECIFICATIONS:

Operating Position -	Any
Input Coupling, rf - -	TNC
Output Coupling, rf -	TNC
Focusing - - - - -	PPM, magnetically shielded
Cooling - - - - - -	Heat Sink conduction
Dimensions - - -	See outline drawing
Weight - - - - - -	9 ounces, encapsulated
H.V. Leads - - - -	Flying

APPLICATION NOTES

VOLTAGES REFERENCE: ALL VOLTAGES ARE WITH RESPECT TO CATHODE.

COOLING: Tube is cooled by conduction through base. With depressed collector and rf output at saturation, 6.0 watts are dissipated.

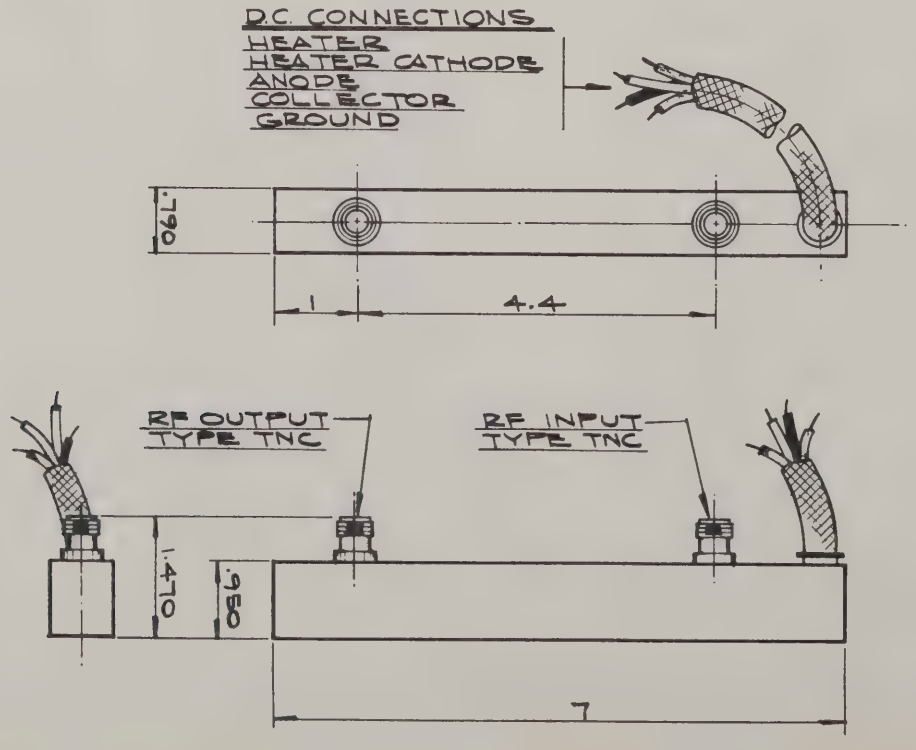
COLLECTOR: Depressed up to 65% for full rf output. Collector is completely encapsulated and insulated.

HELIX: Grounded. Can be supplied floating for modulation capability.

FOCUS ELECTRODE: Used to gate off the tube in certain applications.

MISSION: This is a high reliability tube with a design "wearout" of 100,000 hours. Reliability coupled with high efficiency and light weight makes this tube ideal for long mission space applications.

DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN



Eimac®

EITEL-McCULLOUGH, INC.

X1132

TRAVELING WAVE TUBE - POWER SUPPLY PACKAGE

7.0 - 8.0 Gc
3.0 WATTS
36 db GAIN

TENTATIVE DATA SHEET
TRAVELING WAVE TUBE AMPLIFIER POWER SUPPLY PACKAGE X1132

The X1132 is a long life, highly reliable amplifier package consisting of a PPM focused ceramic-metal TWT amplifier (X1131) and integral solid state power supply designed for space applications. Over the frequency range of 7.0 to 8.0 Gc, 2.5 Watts of rf power are produced at a saturated gain of 36 db.



ELECTRICAL SPECIFICATIONS:

Absolute Ratings	Maximum	Minimum
Power Supply Voltage	40	20 V
Power Supply Power	16	- W
Duty Cycle	100	- %
Input Power, rf	100	0 mw
Power Reflected From Load	3.0	- W
Temperature, Collector	+150	- 40° C
Ambient Temperature	+80	- 40° C
Altitude	Any	
Operating and Performance Data		
Power Supply Voltage	28	V
Power Supply Current	0.48	A
Duty Cycle	100	%
Frequency Range	7.0-8.0	Gc
Small Signal Gain-Minimum	40	db
-Typical	43	db
Saturated Power-Minimum	2.5	W
-Typical	3.0	W
Saturated Gain-Minimum	36	db
-Typical	38	db
Output VSWR (Cold)	1.5:1	
Input VSWR (Cold)	1.5:1	
Input and Output Impedance	50	ohms
Noise Figure-Maximum	30	db
-Typical	28	db

ENVIRONMENTAL SPECIFICATIONS:

Vibration	20 g's to 2000 cps
Shock	100 g's
Acceleration	20 g's, sustained
Temperature	−20° C to +50° C
Altitude	Any

MECHANICAL SPECIFICATIONS:

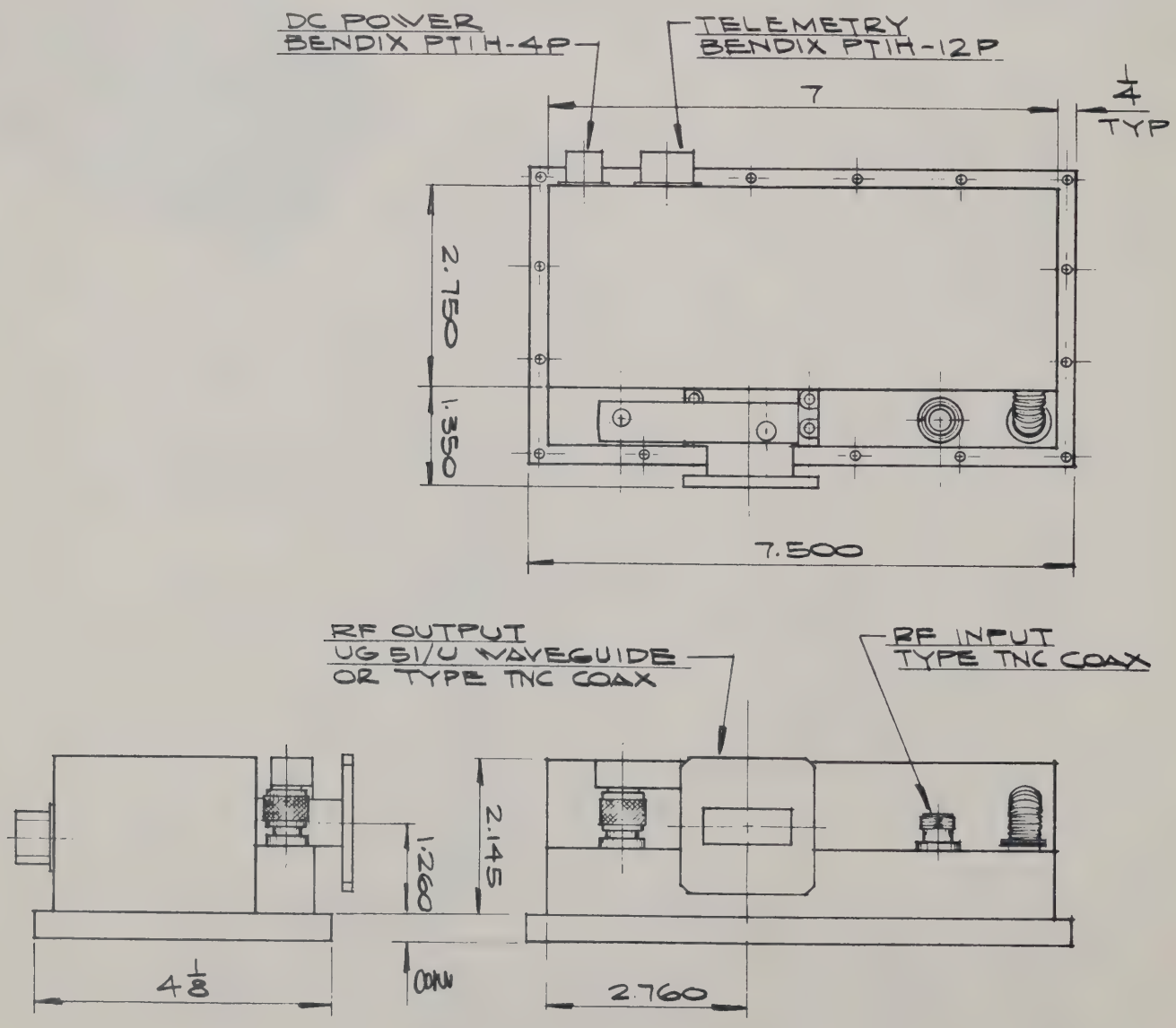
Operating Position	Any
Input Coupling, rf	TNC Coax Fitting
Output Coupling, rf	TNC Coax or UG 51/U Waveguide
Focusing	PPM, shielded
Cooling	Conduction through heat sink
Dimensions	See outline drawing
Weight	4.0 lbs
Power Supply Connections	Bendix PTIH - 3P

Effective 3-6-64 © Copyright 1964 by Eitel-McCullough, Inc., Printed in U.S.A.

APPLICATION NOTES:

1. Full rf performance will be obtained for input voltages between 24 and 30 volts dc.
2. Six telemetry outputs are available for monitoring of TWTA performance.
3. DC operation may be programmed by use of 20 V control signal (draws 10 mW).
4. Especially useful in long unattended mission applications, MTTFF 50,000 hours, rated.
5. Magnetic shield minimizes interference with sensitive components, permits dense packing. Two units may be mounted and operated as close as mechanical outline permits.

DATA SHOULD NOT BE USED FOR FINAL EQUIPMENT DESIGN



TO ALL EIMAC CATALOG HOLDERS

IMPORTANT TECHNICAL INFORMATION TO BE INSERTED
IN YOUR EIMAC HARD COVER CATALOG

Type of Information	New	Revision	Remove Sheet	Dated
General				
Table of Contents		6-30-64	Table of Contents	4-30-64
Eimac Distributors		5-15-64	Eimac Distributors	1-2-64
Diodes-Rectifiers-Pulse Modulators				
575A & 673	3-16-64			
869B & 869BL	3-16-64			
6894 & 6895	3-16-64			
Tetrodes- Pentodes				
4CS100L	4-20-64			
4W20,000A/8173		4-15-64	4W20,000A/8173	2-1-62
Power Klystrons				
4K3SK	3-15-64			
X700	4-25-61			
Other Products				
SK-800B, SK-806	4-9-64		SK-800A, SK-806	9-15-60
SK-810, SK-806		4-9-64	SK-810, SK-806	9-15-60
SK-890B, SK-806	4-9-64		SK-890, SK-806	9-15-60



EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TABLE OF CONTENTS

GENERAL	Effective Date
Eimac Field Representatives	———
Tube Type Numbering System	4-3-58
Distributors	5-15-64
Eimac and EIA Tube Number Cross Reference Sheet	February '64
Power Frequency Chart for Power Grid	———
Power Frequency Chart for CW Power Klystrons	———
Power Frequency Chart for Pulse Power Klystrons	———

DIODES—RECTIFIERS—PULSE MODULATORS	
2-01C	1-22-60
2-25A	7-1-52
2-50A	7-1-52
2-150D	7-1-52
2-240A	10-21-59
2-450A	11-3-59
2-2000A	7-1-52
2X3000F	6-1-63
250R	7-1-52
253	7-1-52
575A & 673	3-16-64
869B & 869BL	3-16-64
6894 & 6895	3-16-64
8020 (100R)	2-1-52
4PR60B/8252	2-15-62
4PR65A/8187	2-15-63
4PR125A/8247	7-15-62
4PR250C/8248	12-1-63
4PR400A/8188	———
4PR1000A/8189	3-20-62
6C21	4-1-54
KY21A	1-2-63
RX21A	1-2-63

TRIODES	
2C39A	10-25-62
2C39WA	2-7-58
3-400Z/8163	6-1-62
3-1000Z/8164	3-20-62
3C24	11-1-51
3CPN10A5/7815	1-1-63
3CPX100A5/7815R	1-1-63
3CV30,000A3	10-1-63
3CW20,000A1	1-1-63
3CW20,000A3	5-1-63
3CW20,000A7	1-1-63
3CW25,000A3	11-1-63
3CX100A5/7289 & 3CX100F5/8250	5-1-62
3CX1000A7/8283	3-1-63
3CX10,000A1/8158	1-1-63
3CX10,000A3/8159	10-20-61
3CX10,000A7/8160	11-1-63
3W5000A1/8240	2-18-63
3W5000A3/8242	10-20-61
3W5000F1/8241	2-18-63
3W5000F3/8243	10-20-61
3X2500A3/8161	11-20-61
3X2500F3/8251	12-5-62
3X3000A1/8238	2-18-63
3X3000A7	5-20-63
3X3000F1/8239	2-18-63
3X3000F7/8162	5-5-61
25T	2-1-51

TRIODES (Continued)	Effective Date
35T	12-30-57
*35TG	5-1-62
75TH	1-2-52
75TL	1-2-52
100TH	4-1-49
100TL	———
*152TH	11-25-52
*152TL	1-1-44
250TH	5-1-53
250TL	1-1-61
304TH	4-10-53
304TL	7-21-58
450TH	8-1-50
450TL	10-1-49
592/3-200A3	7-1-54
750TL	12-11-57
1000T	4-22-58
1500T	3-18-59
2000T	10-15-50

TETRODES—PENTODES	
4-65A/8165	5-1-62
4-125A/4D21	6-1-60
4-250A/5D22	5-1-62
4-400A/8438	2-15-63
4-1000A/8166	7-1-62
4CN15A	1-1-63
4CS100L	4-20-64
4CV8000A	11-8-62
4CV20,000A	11-8-62
4CV35,000A	12-3-62
4CV100,000C/8351	6-1-63
4CW2000A	11-19-63
4CW10,000A	4-15-63
4CW50,000C/8350	10-10-62
4CX125C, F	1-1-63
4CX250B/7203 & 4CX250F/7204	7-15-62
4CX250K/8245 & 4CX250M/8246	1-28-63
4CX250R	6-16-61
4CX300A/8167	12-1-63
4CX300Y	11-1-63
4CX350A/8321 & 4CX350F/8322	10-12-62
4CX600A	5-7-63
4CX1000A/8168	11-4-63
4CX1000K/8352	1-1-64
4CX3000A/8169	3-1-63
4CX5000A/8170	2-15-63
4CX5000R/8170W	1-1-63
4CX10,000D/8171	1-20-62
4CX15,000A/8281	10-10-62
4CX35,000C/8349	11-1-63
4W300B	6-16-60
4W20,000A/8173	4-15-64
4X150A & 4X150D	6-15-60
4X150G/8172	8-15-63
4X150R/8296 & 4X150S/8297	5-15-62
4X500A	1-1-64
7580	3-31-61
4E27A/5-125B	8-15-52

POWER KLYSTRONS	
3K2500LX	9-15-58
3K2500SG	4-22-58
3K3000LQ	6-6-58
3K50,000LA, F, Q	5-9-58
3KM3LB	4-1-63

*Not recommended for New Equipment Design.

POWER KLYSTONS (Continued)

	Effective Date
3KM300LA	3-15-64
3KM3000LA	6-6-58
3KM4000LT	11-15-62
3KM50,000PA	7-15-60
4K3CB	10-16-62
4K3SJ	10-26-62
4K3SK	3-15-64
4K50,000LQ	5-28-58
4KM50LB	4-2-63
4KM50SK	5-2-63
4KM70SJ	3-15-62
4KM100LA	9-25-62
4KM3000LQ	9-1-60
4KM3000LR	10-1-60
4KM50,000LA3	10-20-61
4KM50,000LF	10-20-61
4KM50,000LQ	8-15-60
4KM50,000LR	10-20-61
4KM170,000LA	10-1-60
4KMP10,000LF	10-1-60
5K210,000LQ	10-20-61
5KM70SF	11-15-62
X602K	11-15-62
X626AC	10-20-61
X700	4-25-61
WATER LOAD	
WL-150	11-1-63

REFLEX KLYSTRONS TWT—VTM

REFLEX KLYSTRONS

1K20XD	———
1K20XD-A	12-27-62
1K20XD-S	12-29-62
1K20XF-B	4-1-64
1K20XK	———
1K20XN-A	12-27-62
1K20XS	———
1K015CA, CG	2-16-60
1K75CH, CK	———
1K75CLA	3-15-64
1K75CS	8-10-60
1K125CA	3-15-64
1K125CB	———
EM-1114	3-15-64
X1075	8-10-62
X1075-A	8-10-62
X1079	3-15-64
X1095	3-15-64
X1115	4-1-64
X1115A	3-5-63
X1115B	3-5-63
X1116	4-1-64
X1116A	3-5-63
X1116B	4-1-64
X1117	4-1-64
X1117A	4-1-64
X1117B	4-1-64
X1118	4-1-64
X1118A	4-1-64
X1118B	4-1-64
X1120	6-19-63
X1120B	6-19-63
X1123	4-1-64
X1126	4-1-64
X1126B	4-1-64
X1130	6-19-63
X1149	1-1-64

TWT

EM-108	3-15-64
EM-113	3-15-64
EM-114	3-15-64
EM-116	3-15-64
EM-118	3-15-64
EM-778/8198	4-1-62
EM-779	4-1-62
EM-1006	4-1-62
EM-1010	4-1-62
EM-1011	4-1-62
EM-1015	4-1-62

TWT (Continued)

	Effective Date
EM-1016	4-1-62
X1021	8-1-62
EM-1025	4-1-62
EM-1030	4-1-62
EM-1031	4-1-62
EM-1045	4-1-62
EM-1046	4-1-62
EM-1050	4-1-62
EM-1051	4-1-62
EM-1060	4-1-62

VTM

EM-747	3-15-64
EM-1080	6-14-63
X1081	2-15-63
X1083B	3-15-64
X1084	8-1-62
X1085	7-27-62
EM-1086	10-27-62
X1087	1-1-64
X1088B	3-15-64
X1091	10-27-62
X1092	3-5-63
EM-1093	3-15-64
X1094	3-15-64
X1097	6-14-63
X1098	3-1-64
X1099	3-15-64
X1150	3-15-64

TWO-CAVITY KLYSTRONS

X1111	3-15-64
X1113	3-15-64

OTHER PRODUCTS

VS-2, 4, 5, & 6	12-1-63
100 IG Ionization Gauge	6-15-53
Preformed Contact Finger Stock	1-15-62
HR Heat Dissipating Connectors	12-12-57
SK-300	1-1-63
SK-306, SK-316	5-21-63
SK-400	4-1-56
SK-406, SK-416	5-17-63
SK-410	11-15-62
SK-500	3-1-56
SK-506, SK-516	5-21-63
SK-510	5-4-63
SK-600	3-31-61
SK-606, SK-626, SK-636B	5-24-63
SK-610	3-31-61
SK-620, SK-620A	1-15-63
SK-630, SK-630A	1-18-63
SK-640	3-31-61
SK-650 and SK-655	3-31-61
SK-700, SK-710, SK-606	1-20-58
SK-711A	5-9-63
SK-740	5-9-63
SK-760, SK-770	5-9-63
SK-800B, SK-806	4-9-64
SK-810, SK-806	4-9-64
SK-860, SK-870	5-9-63
SK-890B, SK-806	4-9-64
SK-900, SK-906	6-1-60
SK-1300	5-9-63
SK-1306, SK-1406	5-17-63
SK-1400A, SK-1470A	5-9-63

CAVITY AMPLIFIER

EM-4500	1-1-64
EM-4501	11-1-63
EM-4506	1-1-64
EM-4507	11-1-63
EM-4512	1-1-64
EM-4515	1-1-64
EM-4516	11-1-63
EM-4523	1-1-64
EM-4524	2-1-64
X4539	3-5-63
X4540	3-5-63
X4546	9-1-63

EIMAC DISTRIBUTORS

Effective May 15, 1964

ALABAMA

Birmingham
Ack Radio Supply Company
3101 4th Avenue South
(205) 322-0588
James W. Clary Company, Inc.
1713 Second Avenue, South
(205) 322-2488
M. G. Electronics & Equip. Co.
3112 6th Avenue, South
(205) 322-0449

Dothan
Hand Supply Company
705 South Oates Street
(205) 792-3148

Gadsden
Southeastern Radio Parts Company
120 Chestnut Street
(205) 546-4675

Huntsville
Electronic Wholesalers, Inc.
2310 Wallace Avenue, S.W.
534-2461
M. G. Electronics & Equipment Co.
4306 Governors Drive
(205) 534-0608

Mobile
Forbes Electronic Distributor
57 No. Washington Avenue
(205) 432-7661
Specialty Distributing Company
1276 Beltline Highway South
(205) 344-0450

Montgomery
Southeastern Radio Parts Co.
635 Jefferson Street
(205) 263-6488

Opelika
Southern Electronics Corp.
309 South 10th Street
(205) 745-5298

ALASKA

Anchorage
Yukon Radio Supply
Box 406
272-7964

Juneau
Alaska Radio Supply
Box 2538
586-3333

ARIZONA

Phoenix
Radio Parts of Arizona
214 South 11th Avenue
(602) 258-6476

Tucson
Inland Electronic Supply Co.
715 East Broadway
(602) 624-4402

ARKANSAS

El Dorado
Electronic Service Supply
428 West Main Street
(501) 862-4901

Fort Smith
Wise Radio & TV Supply, Inc.
1001 Towson Avenue
(501) 783-8926

Little Rock
Carlton-Bates Company
1210 East Sixth Street
(501) 375-5375
David White Radio Supply Co.
1222 Main Street
(501) 376-1391

Texarkana
Lavender Distributing Corp.
520 E. Fourth Street
773-4631

CALIFORNIA

Anaheim
Federated Purchasers, Inc.
266 North Manchester
(714) 628-5155
R. V. Weatherford Company
1651 South State College Blvd.
(714) 547-7521

Burlingame
Amrad Electronics
999 Howard Avenue
(415) 342-5757

Chico
Dunlap Electronics
824 Cherry Street
(916) 342-8313

Fresno 21,
Jack C. Arbuckle Company
2349 Kern Street
(209) 264-6554
Dunlap Electronics
355 M Street 93717
(209) 268-6111

Glendale
R. V. Weatherford Company
6921 San Fernando Road
(213) 849-2471

Lancaster
Manley's Electronic Supply
45003 North Yucca Avenue
(213) 948-1687

Los Angeles
Federated Purchasers, Inc.
11820 West Olympic Blvd.
(213) 272-8771
Radio Product Sales Co.
1501 So. Hill Street
(213) 748-1271

Marysville
Dunlap Electronics
1012 Sixth Street 95901
(916) 742-7126

Merced
Dunlap Electronics
234 W. 17th Street
(209) 722-3936

Modesto
Dunlap Electronics
419 Tenth Street
(209) 524-5191

Mountain View
Alcom Electronics
2025 Middlefield Road
(415) 968-7388

Oakland
Brill Electronics
610 E. 10th Street
(415) 832-6100
Elmar Electronics, Inc.
140 – 11th Street
(415) 834-3311

Palo Alto
Zack Electronics
654 High Street
(415) 326-5432

Pomona
R. V. Weatherford Company
1095 E. 3rd Street
(213) 623-1261

Redding
Dunlap Electronics
3082 Bechelli Lane
243-4949

Riverside
Electronic Supply, Inc.
2486 Third Street
(714) 683-8110

Sacramento
Dunlap Electronics
1800 – 18th Street
(916) 444-8070
Sacramento Electronic Supply Co.
1219 S Street
(916) 441-4821

San Diego
Electronic Components, Inc.
2060 India Street
(714) 239-9361
Western Radio & Television Supply Co.
1415 India Street
(714) 239-0361

San Francisco
Fortune Electronics
2280 Palou Avenue
(415) 826-8811
Zack Electronics
1444 Market Street
(415) 621-1444

San Jose
Peninsula Electronic Supply
656 S. First Street
(408) 294-8781

Stockton
Dunlap Electronics
27 S. Grant Street
P.O. Box 1970 95201
(209) 446-3373

COLORADO

Colorado Springs
D & M Electronics
717 N. Weber
(303) 633-0902

Denver
Kierulff Electronics
1200 Stout Street
(303) 825-7033
L. B. Walker Radio Company
300 Bryant Street
(303) 935-2401
Newark-Denver Elect. Supply Co.
2170 So. Grape Street
(303) 757-3351

Grand Junction
Radio & Electronic Supply Co.
640 White Avenue
(303) 243-3346

Pueblo
L. B. Walker Radio Company
100 No. Victoria
(303) 542-1924

CONNECTICUT

Hamden
Cramer Electronics, Inc.
60 Connally Parkway
(203) 288-7771

New Haven
Radio Shack Corporation
92 York Street
(203) 777-7941

DISTRICT OF COLUMBIA

Washington
Capitol Radio Wholesalers, Inc.
2120–22 – 14th Street, N. W.
(202) 232-6000
Electronic Wholesalers, Inc.
2345 Sherman Avenue, N. W.
(202) 483-5200

EIMAC DISTRIBUTORS

FLORIDA

Ellenton
Bill Slep Company
P. O. Box 178
722-1843

Jacksonville
Southeast Electronics, Inc.
1125 Rosselle Street
(305) 356-3007

Melbourne
Electronic Wholesalers, Inc.
1301 Hibiscus Blvd.
723-1441

Miami
Amateur Radio Center, Inc.
2805 N. E. 2nd Avenue
(305) 374-4101
East Coast Electronics, Inc.
1900 N. W. Miami Court
(305) 371-4635
Electronic Equipment Co. Inc.
2701 N. W. 42nd Avenue
(305) 635-0421
Electronic Wholesalers, Inc.
9390 N. W. 27th Avenue
(305) 696-1620

Orlando
Hammond Electronics Inc.
911 West Central Blvd.
(305) 241-6601

Panama City
Central Electronic Supply
316 Luverne Avenue
(305) 785-4821

Tampa
Thurow Electronics Inc.
121 South Water Street
(813) 229-1885

West Palm Beach
Goddard, Inc.
1000 North Dixie Highway
(305) 833-5701

GEORGIA

Atlanta 8,
Specialty Distributing Co., Inc.
763 Juniper Street, N. E.
(404) 873-2521

HAWAII

Honolulu
Honolulu Electronics
819 Keeamuoku Street
999-591
Industrial Electronics Inc.
646 Queen St.
506-095
Pacific Electronics
1336 Dillingham Blvd.
817-118
Precision Radio Ltd.
1160 South King Street
58-291
Radio Television Corp. Ltd.
432 Keawe Street
564-416

IDAHO

Twin Falls
United Electronics Wholesale
328 Third Street East
(208) 733-7324

ILLINOIS

Chicago
Allied Radio Corp.
100 North Western Avenue
(312) 829-9100
Newark Electronics Corp.
223 West Madison Street
(312) 782-2944
Arthur H. Richardson Inc.
Suite 343, 608 South Dearborn
(312) 939-4528

LaSalle
Klaus Radio & Electric Company
1055 1st Street
CA 3-7400

Peoria
Klaus Radio & Electric Co.
403 East Lake Street
(309) 688-3401

Quincy
Klaus Radio & Electric Company
1101 S. Broadway
BA 3-7560

INDIANA

Indianapolis
Graham Electronics Supply Co.
122 South Senate
(317) 634-8486

IOWA

Cedar Rapids
Deeco, Inc.
618 First Street, N. W.
(319) 365-7551

Council Bluffs
World Radio Labs.
3415–27 West Broadway
(712) 328-1851

Davenport
T. C. R. Distributing, Inc.
1205 East River Drive
(319) 323-8051
Klaus Radio & Electric Company
311 E. 2nd Street
326-4436

Des Moines
Radio Trade Supply Company
1224 Grand Avenue
(515) 288-7237

Mason City
Waters Electronic Supply
516 S. Delaware
(515) 423-5889

KANSAS

Wichita
Radio Supply Company, Inc.
115 Laura
(316) 267-5214

KENTUCKY

Louisville 3,
P. I. Burks & Company, Inc.
659 South Ninth Street
(502) 583-2871

Owensboro
Ohio Valley Sound
600 W. Third Street
(502) 683-6727

LOUISIANA

Alexandria
Central Radio Supply
601 N. Third Street
(318) 443-4517

Lafayette
Ralph's of Lafayette, Inc.
3004 Cameron
(318) 234-4507

New Orleans
Radio Parts, Inc.
1112 Magazine Street
(504) 522-0217
Southern Radio Supply Company
1909 Tulane Avenue
(504) 524-2345

Shreveport
Industrial Electronic Supply, Inc.
2422 Southern Avenue
(318) 422-9459
Interstate Electric Company
1419 Culpepper Street
(318) 423-6131

MARYLAND

Baltimore
Kann-Ellert Electronics, Inc.
2050 Rockrose Avenue
(301) 889-4242

MASSACHUSETTS

Boston
DeMambro Electronics
1095 Commonwealth Ave.
(617) 783-1200
Radio Shack Corp.
730 Commonwealth Avenue
(617) 734-6811

Newton
Cramer Electronics, Inc.
320 Needham Street
(617) 969-7700

Springfield
Soundco Electronic Supply Co., Inc.
147 Dwight Street
(413) 739-3847

MICHIGAN

Battle Creek
Electronic Supply Corporation
94 Hamblin Avenue
(517) 965-1241

Detroit 37,
Newark-Ferguson Electronics, Inc.
20700 Hubbell
(313) 564-5490

Flint
Shand Radio Specialties, Inc.
2401 South Dort Highway
(313) 238-0477

MINNESOTA

Duluth
Northwest Radio
123 East First Street
(218) 727-1565

Mankato
Southern Minnesota Supply Co.
Corner 2nd & Main
(507) 388-6245

Minneapolis
Electronic Center
107 Third Avenue North
(612) 338-8678
Lew Bonn Company
1211 La Salle Avenue
(612) 339-9461

St. Paul
Stark Electronic Supply
154 University Avenue
(612) 222-4781

MISSISSIPPI

Hattiesburg
Swan Electronics, Inc.
506 Bouie Street
P. O. Box 766
JU 4-5494

Jackson
Swan Electronics, Inc.
342 North Gallatin Street
(601) 352-5516

MISSOURI

Butler
Henry Radio Company
211 North Main Street
(816) 679-3127

Joplin
Four State Radio Supply Company
402 Wall Street
(417) 624-0368

Kansas City
Burstein-Applebee Company
1012–14 McGee Street
(816) 221-1155

MISSOURI (Continued)

Walters Radio Supply Company
3635 Main Street
(816) JE 1-7015

St. Louis

Interstate Industrial Elect., Inc.
2218 South Jefferson Avenue
(314) 994-7585

Olive Electronic Supply Company
6662 Olive
(314) 863-4051

Van Sickle Radio Company
1113 Pine Street
(314) CH 1-2700

Walter Ashe Radio Company
1125 Pine Street
(314) 241-1125

MONTANA

Billings

Electronic Supply Company
250 11th Street
(406) 252-2197

Interstate Distributing Company
2112 – 4th Avenue N.
P. O. Box 2523
(406) 245-5141

NEBRASKA

Lincoln

Scott Electronic Supply Corp.
2201–2207 "O" Street
(402) 432-6558

Scottsbluff

Joachim Radio Supply Co.
1913 Broadway
(308) 632-2181

NEVADA

Las Vegas

Electronic Supply Co.
1112 South 2nd Street
(702) 384-5666

Reno

Dunlap Electronics
555 Eureka
P. O. Box 2471
(702) 329-1308

Electronic Dist. Co. of Nevada
720 Tahoe Street
(702) 323-2766

NEW HAMPSHIRE

Concord

Evans Radio, Inc.
P. O. Box 312
(603) 225-3358

NEW JERSEY

Springfield

Federated Purchasers, Inc.
155 U.S. Route 22
(212) DI 9-3050
(201) AD 2-8200

NEW MEXICO

Alamagordo

Kierulff Electronics Co., Inc.
209 Pennsylvania Avenue
(505) 437-0370

Albuquerque

Midland Specialty Company
1712 Lomas Blvd., N. E.
(505) 247-2486

Radio Equipment Company
523 Central Avenue
(505) 242-5681

Roswell

R & R Electronic Supply Co.
605 East 2nd Street
(505) 622-0670

NEW YORK

Albany

Ft. Orange Radio Dist. Co., Inc.
904–916 Broadway
(518) 436-8411

Buffalo

Radio Equipment Corp.
312 Elm Street
(716) 856-1415

Farmingdale, L. I.

Arrow Electronics, Inc.
900 Broad Hollow Rd. (Rt. 110)
(516) 694-6800

Lynbrook, L. I.

Peerless Radio Dist., Inc.
19 Wilbur Street
(516) 593-2121

New York City

Barry Electronics Corp.
512 Broadway
(212) 925-7000

Calvert Electronics, Inc.
220 East 23rd Street
(212) 679-1340

Electronic Tube Sales
161 Washington Street
(212) 227-4141

Harrison Radio Corp.
227 Greenwich Street
(212) 227-7777

Harvey Radio Corporation, Inc.
103 West 43rd Street
(212) JU 2-1500

Milgray Electronics, Inc.
160 Varick Street
(212) 989-1600

Milo Electronics Corp.
530 Canal Street
(212) 233-2980

State Labs., Inc.
215 Park Avenue, South
(212) 677-8400

Terminal-Hudson Electronics, Inc.
236 W. 17th Street
(212) 243-5200

Visual Electronics Corp.
356 West 40th Street
(212) PE 6-5840

Rochester

Rochester Radio Supply Inc.
140 West Main Street
(716) 562-9900

Syracuse

Syracuse Radio Supply
500 West Fayette
(315) 475-0161

NORTH CAROLINA

Asheville

Freck Radio & Supply, Inc.
38 Biltmore Avenue
(704) 254-9551

Charlotte

Dixie Radio Supply Company
1431 Bryant Street
(704) 334-6488

Greensboro

Carolina Radio Supply Company
838 Huffman Street
(919) 273-8669

Raleigh

Southeastern Radio Supply Co. Inc.
414 Hillsboro Street
(919) 828-2311

Winston-Salem

Electronic Wholesalers, Inc.
938 Burke Street
(919) 725-8711

NORTH DAKOTA

Fargo

Bristol Distributing Co.
1345 Main Street
(701) 232-7493

Minot

John Iverson Company
216 2nd Street, S. W.
(701) 832-3117

OHIO

Cincinnati

Hughes-Peters, Inc.
1128 Sycamore Street
(513) 381-7625

Cleveland

Pioneer Electronics
5403 Prospect Avenue
(216) 432-0010

Columbus

Hughes-Peters, Inc.
481 East 11th Avenue
(614) 294-5351

Dayton

Esco Electronics, Inc.
3130 Valleywood Drive
(513) 298-7461

Srepco Electronics, Inc.
314 Leo Street
(513) 224-0871

Stotts-Friedman Company
108–112 N. Jefferson Street
(513) 224-1111

Toledo

Warren Radio Company
1002 Adams Street
(419) 248-3364

Youngstown

Ross Radio Co.
325 West Federal Street
(216) 746-8881

OKLAHOMA

Oklahoma City

Radio Supply, Inc.
724 North Hudson Street
(405) 232-6128

Tulsa

Radio, Inc.
1000 South Main Street
(918) 587-9124

S & S Radio Supply
537 South Kenosha Street
(918) 582-7173

OREGON

Medford

Verl G. Walker Company
205 West Jackson Street
(503) 773-7557

Portland

Lou Johnson Company
1506 N. W. Irving Street
(503) 222-9551

United Radio Supply Inc.
22 N. W. 9th Avenue
(503) 226-6334

PENNSYLVANIA

Altoona

Allegheny Electronics, Inc.
1720 Union Avenue
(814) 944-0828

Philadelphia

Almo Industrial Electronics, Inc.
412 N. 6th Street
WA 2-3503

JOA Cartridge Service
P. O. Box 3087
Wadsworth Station
TUrner 6-7993

Philadelphia Electronics, Inc.
1225–27–29 Vine Street
(215) 568-7444

Pittsburgh

Cameradio Company
1121 Penn Avenue
(412) 391-4000

Radio Parts Company Inc.
6401 Penn Avenue
(412) 362-6620

Reading

George D. Barbey Company
333 N. 4th Street
(215) 376-7451

Scranton

Fred P. Pursell
1221–27 N. Washington Avenue
(717) 346-2011

PENNSYLVANIA (Continued)

State College
Alvo Electronics Distributors, Inc.
103 South Pugh Street
(814) 238-6277

Wyncote
JOA Cartridge Service
132 Heacock Lane
(215) TU 6-7993

SOUTH CAROLINA

Charleston
Wholesale Radio Supply Company
515 East Bay Street
(803) 722-2634

Columbia
Dixie Radio Supply Company
1900 Barnwell Street
(803) 253-5333

Greenville
Carolina Radio Supply Co. Inc.
221 West Washington Street
(803) 239-5125

SOUTH DAKOTA

Rapid City
Ellis Electronics Company
235 East Main
(605) 342-0360

Sioux Falls 1,
Warren Radio Supply
P. O. Box 958
(605) 334-6942

Watertown
Burghardt Radio Supply
P. O. Box 746
(605) 886-5749

TENNESSEE

Chattanooga
Specialty Distributing Co., Inc.
1313 Central Avenue
(615) 267-9531

Jackson
L. K. Rush Company
425 N. Royal Street
(901) 422-6533

Knoxville
McClung Appliances
310 Georgia Street, N.E.
(615) 524-1811

Memphis
Lavender Radio Supply Company
180 S. Cooper Street
(901) BR 6-2757
W & W Distributing Co.
644-46 Madison Avenue
(901) 527-4627

Nashville
Electra Distributing Company
1914 West End Avenue
(615) 255-8444

Tullahoma
Randolph & Holt, Inc.
304 South Atlantic St.
(615) 455-4531

TEXAS

Beaumont
Sterling Electronics Inc.
1160 Laurel
(713) 833-7503

Corpus Christi
Elec. Equip. & Engrg. Co.
805 South Staples Street
(512) 883-9271

Dallas
Adleta Company
1914 Cedar Springs
(214) 741-3151
Engineering Supply Company
6000 Denton Drive
(214) 357-6121
Wholesale Electronic Supply
2809 Ross Avenue
(214) 824-3001

El Paso
C. C. McNicol, Inc.
3012 E. Yandell Street
566-2936
Midland Specialty Company
2235 Wyoming Street
533-9555

Houston 19,
Busacker Electronic Equip.
1216 West Clay Street
(713) 526-4661

Laredo
Guarantee Radio Supply Company
1314 Iturbide Street
(512) 722-3233

Lubbock
Nunn Electric Supply Corp.
1817-4th Street
P.O. Box 192
(806) POrter 5-5741

San Antonio
The Perry Shankle Company
1801 South Flores Street
(512) 223-1801

UTAH

Ogden
Ballard Supply Corp.
3109 Washington Blvd.
(801) 394-5541

Salt Lake City
Ballard Supply Corp.
44 East 6th South Street
(801) 364-6541
Electronic Sales Corp. (ELSCO)
2275 S.W. Temple
(801) 466-8631
S. R. Ross, Inc.
1212 South State
(801) 328-0591
Standard Supply Company
225 E. 6th South Street
(801) 355-2971

VIRGINIA

Charlottesville
Virginia Radio Supply Co., Inc.
Box 1189
715 Henry Avenue
(703) 296-4184

Norfolk
Priest Electronics, Inc.
6431 Tidewater Drive
(703) 885-2021

Richmond
Meridian Electronics, Inc.
1001 West Broad Street
(703) 355-2834

Roanoke
H. C. Baker Sales Company, Inc.
17–19 Franklyn Road, S.W.
(703) 344-9209

WASHINGTON

Bellingham
Advanced Electronics
804 Dupont 98225
(509) 733-0280

Seattle
C & G Electronics Co.
2600 – 2nd Ave.
(206) 624-4354
Graybar Electric Company, Inc.
King & Occidental Streets
(206) 682-0123
Robert E. Priebe Company
2228 Second Avenue
(206) 682-4354

Spokane
Northwest Electronics, Inc.
730 East First Avenue
(509) 534-2644

Tacoma
C & G Electronics Company
2502 Jefferson Avenue
(206) 372-3181

WEST VIRGINIA

Charleston
Mountain Electronics Company
708 Bigley Avenue
(304) 344-3411

WISCONSIN

Eau Claire
Indianhead Electronic Supply
515 Wisconsin Street 54701
TEmple 4-3606

Madison
Satterfield Electronics, Inc.
1900 South Park Street
(608) 257-4801

Milwaukee
Radio Parts Company, Inc.
1314 North 7th Street
(414) 276-4160

WYOMING

Casper
Fleming Supply Inc.
328 East 'A' Street
(307) 236-6056
Hathaway Electronic Supply
333 North Wolcott Street
(307) 234-1821

Cheyenne
Houge Radio & Supply Company
4012 Central Avenue
(307) 632-6474

575A
673

MERCURY-VAPOR RECTIFIERS

The Eimac 575A and 673 are half-wave mercury vapor-rectifiers incorporating features which enable them to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The tubes differ only in basing.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage		5.0 volts
Current		9.0 to 11.5 amperes
Filament Heating Time		30 seconds
Anode Starting Voltage (approx.)		20 volts

MECHANICAL

Base	575A	50 watt, A4-29
	673	Industrial, A4-18
Recommended Socket	575A	E. F. Johnson #123-211
	673	E. F. Johnson #123-206
Maximum Overall Dimensions:		
Length	575A	11-1/8 inches
	673	11-7/16 inches
Diameter		2-9/16 inches
Net Weight		12 ounces

MAXIMUM RATINGS (per tube)

CONDENSED MERCURY TEMPERATURE LIMITS*	20-50	20-60° C
PEAK INVERSE ANODE VOLTAGE	15	10 MAX KV
PEAK ANODE CURRENT:		
Quadrature Filament Excitation**	10	10 MAX AMPS
In-Phase Filament Excitation	6	7 MAX AMPS
AVERAGE ANODE CURRENT: (Maximum averaging time-20 seconds)		
Quadrature Filament Excitation**	2.5	2.5 MAX AMPS
In-Phase Filament Excitation	1.5	1.75 MAX AMPS
MAXIMUM AC SHORT CIRCUIT CURRENT***	100	100 MAX AMPS

*Condensed Mercury temperature rises approximately 18° C above ambient.
**Quadrature excitation refers to filament voltage 90° ±30° out of phase with anode voltage.
***Max. duration 100 milliseconds.

APPLICATION

MECHANICAL

MOUNTING: The 575A and 673 must be mounted vertically base down.

COOLING: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury should be kept within the ranges given under "MAXIMUM RATINGS."

This temperature should be maintained at 40° ±5° C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recom-

(Effective 3-16-64) © Copyright 1964 by Eitel-McCullough, Inc.

mended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube. The approximate condensed mercury temperature rise above ambient is 18° C.

ELECTRICAL

FILAMENT VOLTAGE: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range of 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

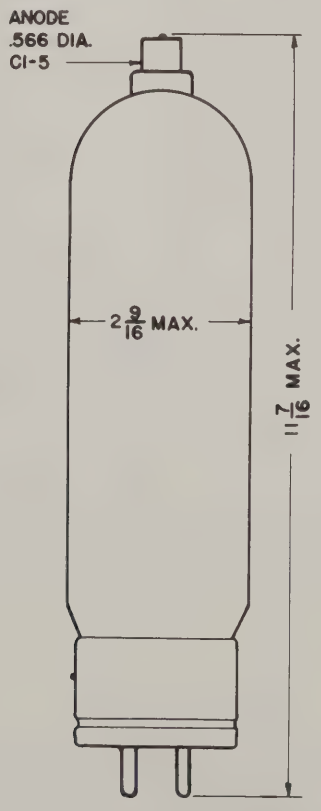
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

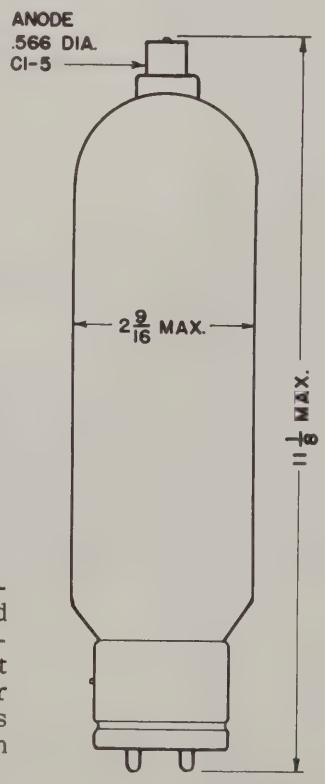
When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

SHIELDING: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the tube should be isolated from such fields as exist around a transmitter or other similar equipment.

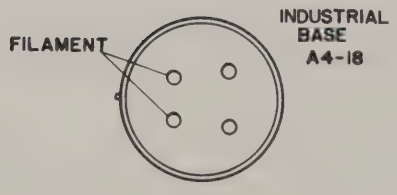
673

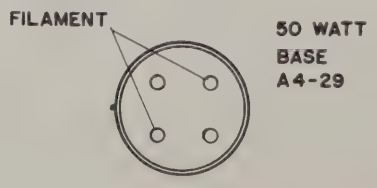


575-A



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with Eitel-McCullough, Inc.





Eimac

EITEL-McCULLOUGH, INC.

869B
869BL

MERCURY-VAPOR RECTIFIERS

The Eimac 869B and 869BL are half-wave mercury vapor-rectifiers incorporating features which enable them to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The 869B and 869BL carry maximum ratings of 20 kV peak inverse voltage, 5 amperes dc and 20 amperes peak cathode current.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated	
Voltage	5.0 volts
Current	17 to 21 amperes
Filament Heating Time	60 seconds
Anode Starting Voltage (approx.)	30 volts

MECHANICAL

Base	See Drawing
Maximum Overall Dimensions:	
Length	14-7/16 inches
Diameter	3 inches
Net Weight	20 ounces

MAXIMUM RATINGS (Single Tube)

CONDENSED MERCURY TEMPERATURE RANGE*	-30-60	30-50	30-40° C
PEAK INVERSE ANODE VOLTAGE	10	15	20 MAX KV
PEAK ANODE CURRENT:			
Quadrature Excitation**	20	20	20 MAX AMPS
In-Phase Excitation	10	10	10 MAX AMPS
AVERAGE ANODE CURRENT: (30 second maximum averaging time)			
Quadrature Excitation	5.0	5.0	5.0 MAX AMPS
In-Phase Excitation	2.5	2.5	2.5 MAX AMPS
MAXIMUM AC SHORT-CIRCUIT CURRENT ***	100	100	100 MAX AMPS

*Condensed Mercury rises approximately 20° C above ambient.

**Quadrature excitation refers to anode current and filament current 90° ± 30° out of phase.

***Maximum duration 100 milliseconds.

APPLICATION

MECHANICAL

MOUNTING: The 869B and 869BL must be mounted vertically, base down. The 869BL includes 3 inch insulated flexible leads with lugs.

COOLING: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury in the 869B and 869BL should be kept within the ranges given under "MAXIMUM RATINGS."

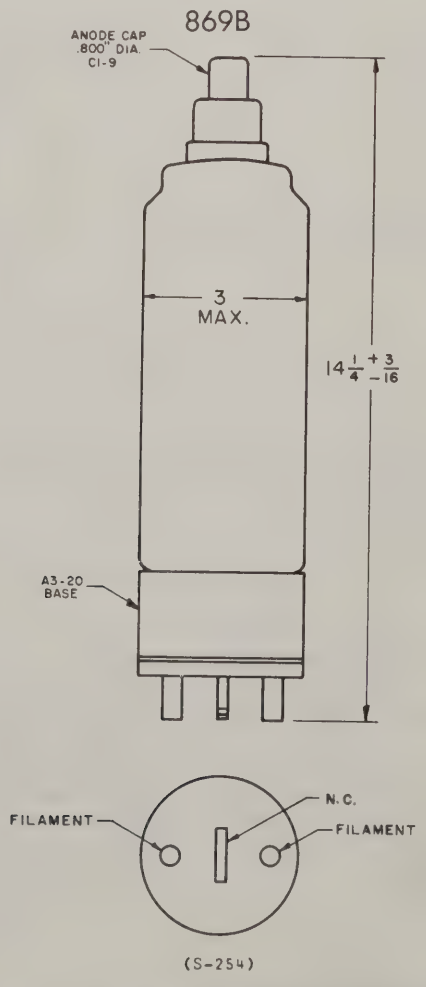
This temperature should be maintained at 40° ±5° C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce

(Effective 3-16-64) © Copyright 1964 by Eitel-McCullough, Inc.

the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.
In some installations a blast of air must be directed at the base of the tube to insure adequate cooling.

ELECTRICAL

FILAMENT VOLTAGE: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range of 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.
The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 60 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.
When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.
X-RAY RADIATION: Above approximately 16,000 peak inverse voltage, a rectifier will produce X-Rays. In most equipment, there is adequate shielding so that this does not constitute a health hazard, however, this should be checked in any new equipment. A standard reference on this subject is "X-Ray Protection, Handbook No. 76," National Bureau of Standards.
SHIELDING: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the 869B and 869BL should be isolated from such fields as exist around a transmitter or other similar equipment.



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with Eitel-McCullough, Inc.

869BL has 3 inch insulated flexible filament leads with spade terminals for #10 screw instead of pins shown on the 869B outline.

Eimac

EITEL-McCULLOUGH, INC.

6894
6895

MERCURY-VAPOR RECTIFIERS

The Eimac 6894 and 6895 are half-wave mercury vapor-rectifiers especially designed for high voltage power rectifier applications. They are mercury filled for high efficiency, long life and the ability to operate at high peak inverse voltage.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage		5.0 volts
Current		9.0 to 11.0 amperes
Filament Heating Time		30 seconds
Anode Starting Voltage (approx.)		20 volts

MECHANICAL

Base	6894	50 watt, A4-29
	6895	Industrial A4-18
Recommended Socket	6894	E. F. Johnson #123-211
	6895	E. F. Johnson #123-206
Maximum Overall Dimensions:		
Length	6894	10-17/32 inches
	6895	10-13/32 inches
Diameter		2-9/16 inches
Net Weight		4 ounces

MAXIMUM RATINGS (per tube)

PEAK INVERSE ANODE VOLTAGE	
20°-50° C Condensed Mercury Temperature Range*	20 MAX KV
20°-55° C Condensed Mercury Temperature Range	15 MAX KV
20°-60° C Condensed Mercury Temperature Range	10 MAX KV
PEAK ANODE CURRENT:	
Quadrature Filament Excitation**	11.5 MAX AMPS
In-Phase Filament Excitation	8.3 MAX AMPS
AVERAGE ANODE CURRENT	
Quadrature Filament Excitation	2.5 MAX AMPS
In-Phase Filament Excitation	1.8 MAX AMPS
MAXIMUM AC SHORT CIRCUIT CURRENT***	100 MAX AMPS

*Condensed Mercury Temperature rises approximately 20° C above ambient.
**Quadrature Excitation refers to filament voltage 90° ±30° out of phase with anode voltage.
***Max. duration 100 milliseconds.

APPLICATION

MECHANICAL

MOUNTING: The 6894 and 6895 must be mounted vertically, base down. These two tubes differ only in their basing and socketry.

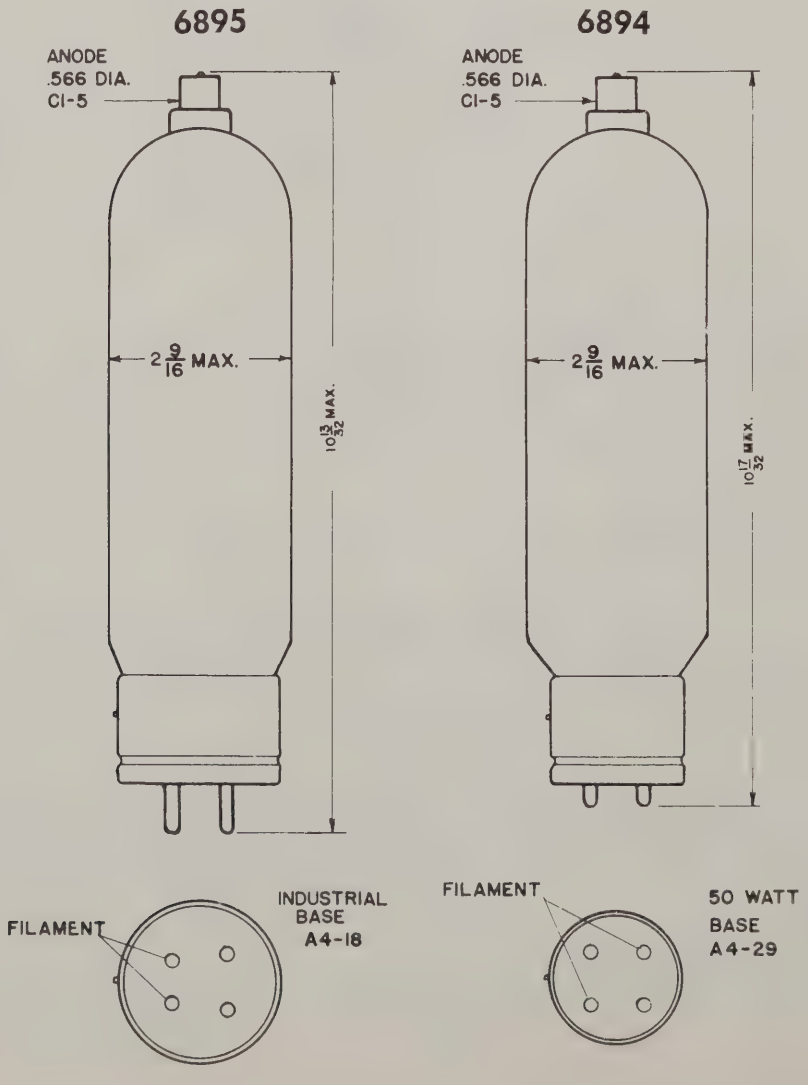
COOLING: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury should be kept

(Effective 3-16-64) © Copyright 1964 by Eitel-McCullough, Inc.

within the ranges given under "MAXIMUM RATINGS."
This temperature should be maintained at 40°±5° C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

ELECTRICAL

FILAMENT VOLTAGE: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.
The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.
When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.
SHIELDING: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the tube should be isolated from such fields as exist around a transmitter or other similar equipment.



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with Eitel-McCullough, Inc.

4CS100L

QUICK-HEAT POWER TETRODE

The Eimac 4CS100L is a metal-ceramic power tetrode with a quick-heating cylindrical cathode intended for use in portable and mobile transmitters. Power output 3 db down from normal is available within one second after the application of rated heater voltage. Tube operation in approximately 150 milliseconds can be obtained by using a built-in control diode and a minimum amount of additional circuitry.

The conduction cooled 4CS100L has a maximum plate dissipation rating of 100 watts and may be operated at frequencies up to 250 megacycles.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-coated, directly heated				
	Heating time (rated filament voltage)	1	2		seconds
	Heating time (at 6.2 volts)		0.15		second
Heater:	Voltage (See "Application")		2.1		volts
	Current (Ef=2.1 volts)		7.15	8.10	amperes
	Absolute Maximum Filament Voltage for fast warm-up (See "Application")		6.2		volts
Amplification Factor (grid to screen)		10	13		
Transconductance (Ib=150 ma)			20,000		umhos

Direct Interelectrode Capacitances, Grounded Cathode:

Input	26.0 pf
Output*	5.2 pf
Feedback	0.05 pf

*When mounted on a metal chassis, approximately 6.0 pf anode-to-ground capacitance is added to this value.

Frequency for Maximum Ratings - 250 Mc

Control Diode Ratings:

Plate Resistance (Id=0.01A, Ec=0v)	1200 ohms
(Id=0.01A, Ec= —40v)	1600 ohms
Plate Dissipation (Maximum)	0.5 watts
DC Plate Voltage (Maximum)	150 volts
DC Plate Current (Maximum)	20 mA

MECHANICAL

Base	Special 9-pin
Recommended Socket	Eimac, SK-660
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic to Metal Seals	250° C
Anode Core	250° C
Cooling	Conduction
Maximum Over-all dimensions:	
Height	2.464 inches
Width	1.728 inches
Net Weight	4 ounces

(Effective 4-20-64) © Copyright 1964 by Eitel-McCullough, Inc.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1 (Single Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	2000 MAX. VOLTS
DC SCREEN VOLTAGE	-	400 MAX. VOLTS
DC PLATE CURRENT	-	200 MAX. MA
PLATE DISSIPATION	-	**100 MAX. WATTS
SCREEN DISSIPATION	-	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	30	30	30 mA
DC Plate Current	150	150	140 mA
DC Screen Current*	5	4	8 mA
Peak RF Grid Voltage*	24	24	24 volts
Plate Input Power	145	220	280 watts
Plate Output Power	65	125	185 watts
Two-Tone Average DC Plate Current	96	96	96 mA
Two-Tone Average DC Screen Current	3	3	3 mA

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1 (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	2000 MAX. VOLTS
DC SCREEN VOLTAGE	-	400 MAX. VOLTS
DC PLATE CURRENT	-	200 MAX. MA
PLATE DISSIPATION	-	**100 MAX. WATTS
SCREEN DISSIPATION	-	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	30	30	30 mA
DC Plate Current	55	55	55 mA
DC Screen Current*	0	0	0
Peak RF Grid Voltage*	12	12	12 volts
Plate Output Power	10	17	30 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	-	2000 MAX. VOLTS
DC SCREEN VOLTAGE	-	400 MAX. VOLTS
DC PLATE CURRENT	-	200 MAX. MA
PLATE DISSIPATION	-	**100 MAX. WATTS
SCREEN DISSIPATION	-	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION (Sinusoidal wave, two tubes)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	60	60	60 mA
Max. Signal DC Plate Current	300	300	280 mA
Max. Signal DC Screen Current	10	8	16 mA
Effective Load, Plate to Plate	4700	8600	13800 ohms
Peak AF Grid input voltage* (per tube)	24	24	24 volts
Driving Power	0	0	0 watts
Max. Signal Plate Output Power	130	250	370 watts

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING

The 4CS100L may be mounted in any position provided that the anode beryllium oxide insulator is properly mated to an adequate heat sink. A heat-conducting socket, such as the Eimac SK-660, or a socket having equivalent characteristics, is required. The screen must be by-passed by the Eimac SK-665 capacitor. This capacitor also includes a provision for a dc connection to the tube's screen ring. There is no pin connection on the tube base for a screen connection.

COOLING

Maximum ratings for the 4CS100L depend on adequate conduction cooling to maintain all tube and seal temperatures at 250° C or below. Maximum anode dissipation depends on intimate mating of the BeO anode insulator to an adequate heat-sink. A conductive lubricant is suggested to insure proper seating of the BeO insulator to the heat-sink. Tube temperatures can be expected to run up to 120° C above the beryllia-to-heat-sink surface temperature.

Base cooling is also by conduction through the Eimac SK-660 socket (or equivalent). To insure proper cooling, tube temperatures should be monitored with temperature sensitive lacquer or by some other means in any new installation.

VIBRATION

This tube is capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in normal operation and handling. The tubes will function well in portable, automobile and truck mobile installations or similar environments.

ELECTRICAL

HEATER OPERATION

With the rated heater voltage of 2.1 volts applied, the warm-up time is approximately 1 second for power output 3 db down from normal. Approximately 2 seconds are required for full output power. The heater voltage must be maintained within ±5% of its rated value to minimize variations in performance and to obtain maximum tube life.

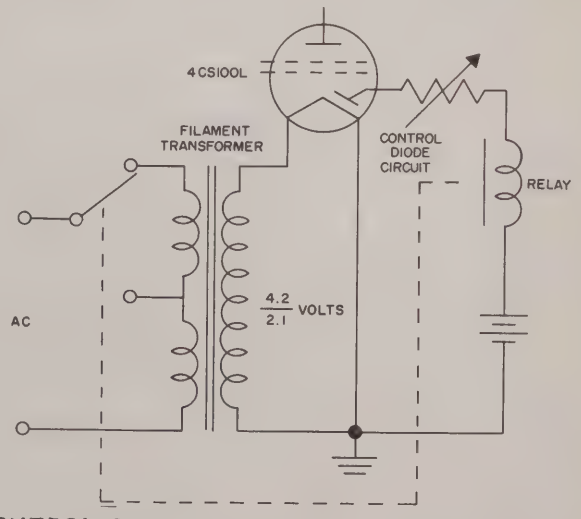
However, the warm-up time may be reduced to approximately 0.15 second by applying overvoltage to the heater for a short period of time, as controlled by the control diode, and then switching to rated heater voltage when the cathode has reached normal operating temperature. Overvoltage must be limited to 3 times nominal (Ef=6.2 volts maximum), for the proper length of time. This feature permits "push-to-talk" operation, of portable and mobile equipment with significant extension of battery life.

CONTROL DIODE OPERATION

Extreme caution must be taken to insure that heater overvoltage is not applied beyond the time at which the cathode reaches operating temperature, since the voltage used is sufficient to destroy the cathode. Proper operation will be insured if overvoltage is removed when control diode anode current reaches 65% of its steady state operating value.

The control diode built into the tube is designed specifically for sensing cathode temperature, and in combination with a properly designed relay circuit will allow overvoltage for a short period followed by a switch to normal voltage. Since the control diode section of the tube is intended for dc switching use only, the control diode anode polarity should not be made negative with respect to the cathode. A typical simplified control circuit is shown; more sophisticated, fail-safe circuits can be used.

In any application, the actual circuit details will depend on such factors as the operating time of the relay used and the degree of overvoltage used initially. It is recommended that the Power Grid Tube Marketing, Eitel-McCullough, Inc., San Carlos, California be contacted for assistance in the use of the Eimac 4CS100L, in applications requiring the use of heater overvoltage.



CONTROL-GRID OPERATION

The grid dissipation rating of the 4CS100L is 0.5 watts and precautions should be observed to avoid exceeding this rating. The 4CS100L is a high transconductance tube requiring low drive voltage for full power output. The design features which make this tube capable of maximum power

operation with low grid drive also make it necessary to avoid drawing significant grid current. Although the tube was designed primarily for Class AB_1 operation, it may be used for Class C applications if the above control grid precautions are carefully observed.

SCREEN-GRID OPERATION

The maximum rated power dissipation for the screen grid is 8 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

Protection for the screen can be provided by an overcurrent relay and by interlocking the screen supply so that the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions, and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

A screen by-pass capacitor such as the Eimac SK-665 may be used. Connection to the screen is made to the contact on the SK-655 or to the screen ring on the tube.

PLATE OPERATION

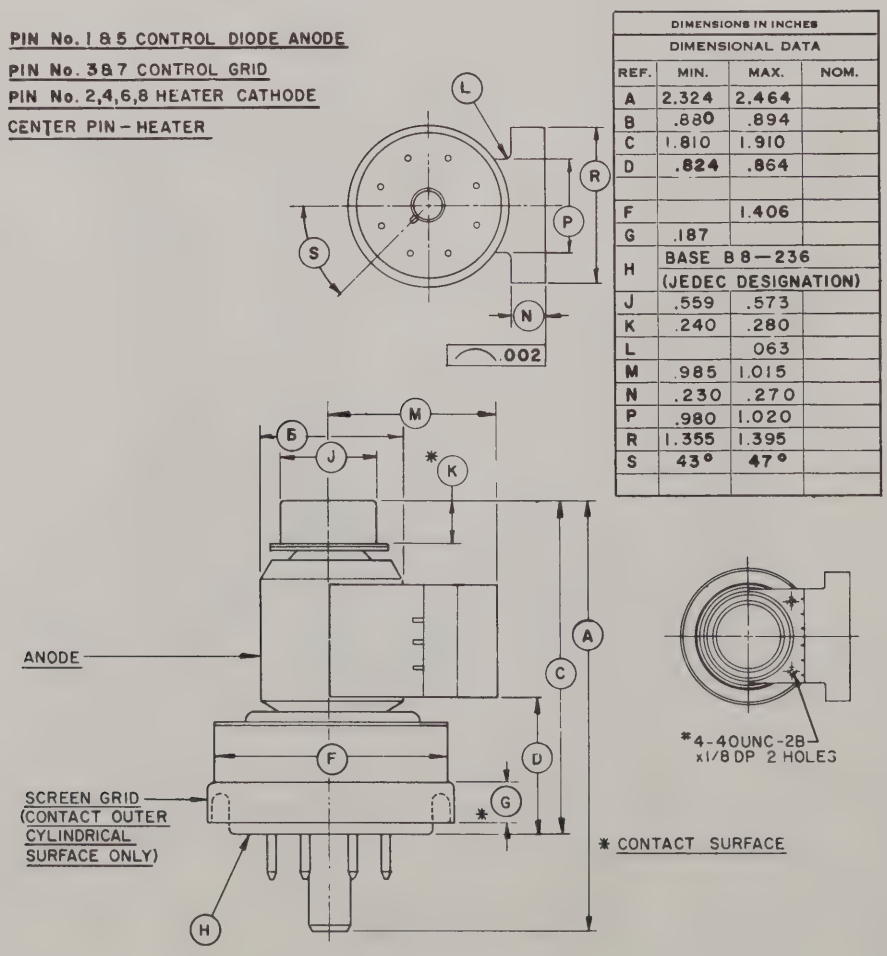
Connection to the anode may be made at the top cap or to the tapped holes on the anode "saddle."

The maximum plate-dissipation rating for the 4CS100L is 100 watts. Plate dissipation may be permitted to exceed the maximum rated value if rated core and seal temperature is maintained.

The maximum rated plate voltage for Class AB_1 operation at frequencies up to 250 megacycles is 2000 volts.

SPECIAL APPLICATIONS

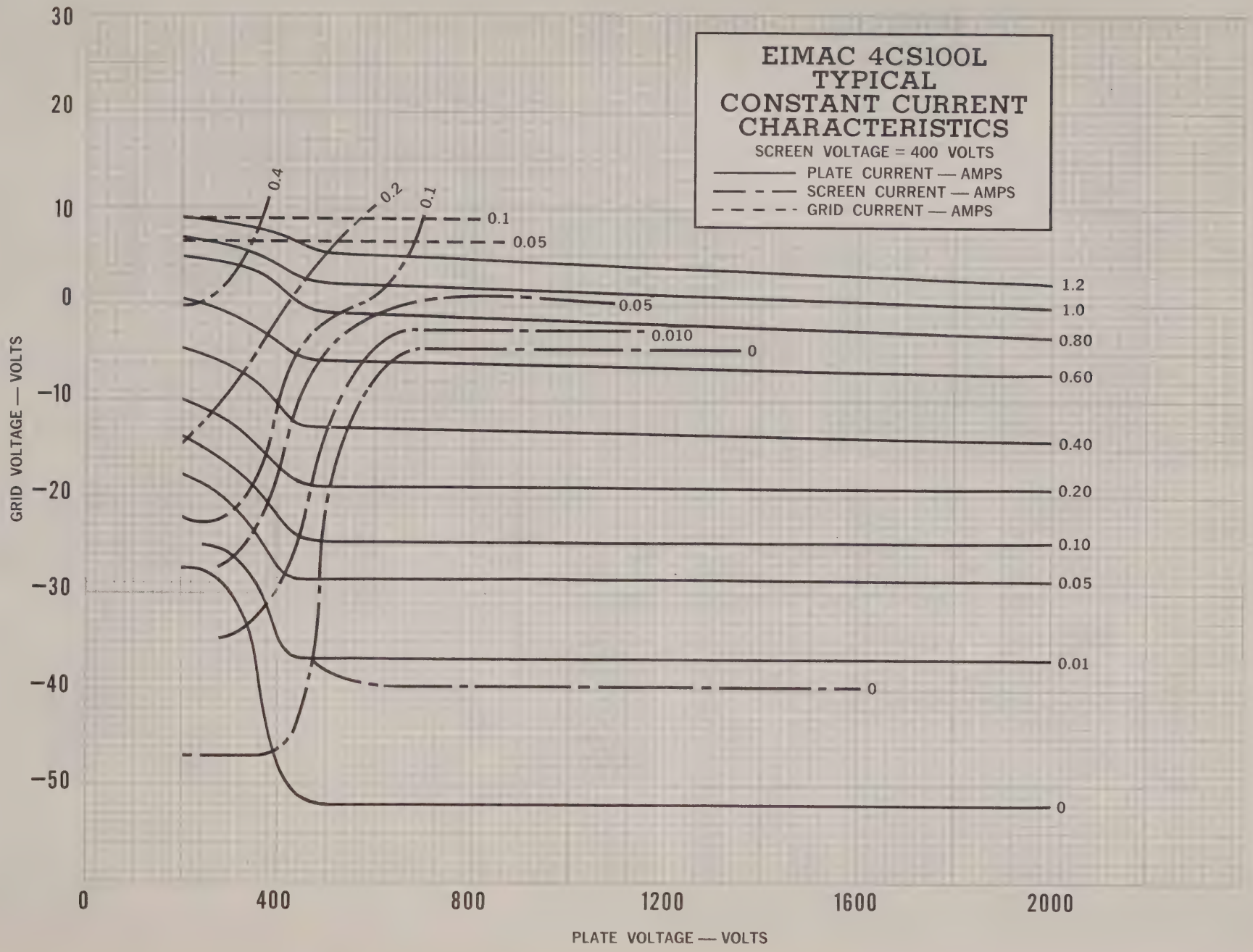
If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

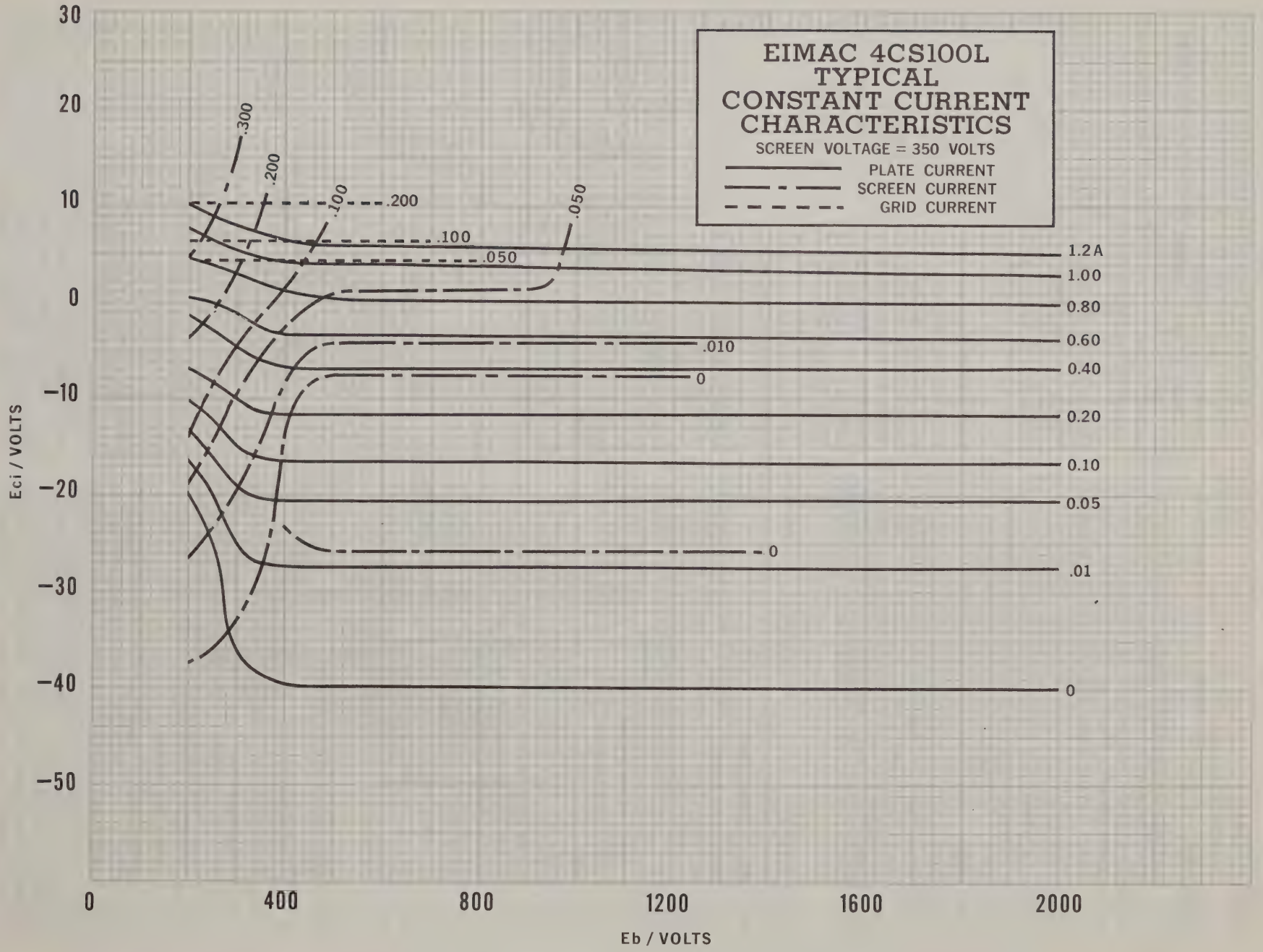


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.324	2.464	
B	.880	.894	
C	1.810	1.910	
D	.824	.864	
F		1.406	
G	.187		
H	BASE B 8–236 (JEDEC DESIGNATION)		
J	.559	.573	
K	.240	.280	
L		063	
M	.985	1.015	
N	.230	.270	
P	.980	1.020	
R	1.355	1.395	
S	43°	47°	

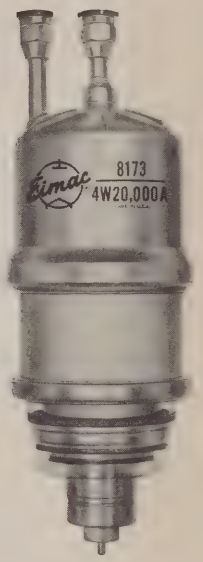

EIMAC 4CS100L
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 400 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
30
20
10
0
−10
−20
−30
−40
−50
0
400
800
1200
1600
2000
0.4
0.2
0.1
0.1
0.05
0.05
0.010
0
1.2
1.0
0.80
0.60
0.40
0.20
0.10
0.05
0.01
0
0


EIMAC 4CS100L
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 350 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
30
20
10
0
−10
−20
−30
−40
−50
Eci / VOLTS
0
400
800
1200
1600
2000
Eb / VOLTS
.300
.200
.100
.050
.200
.100
.050
.010
0
0
0
1.2A
1.00
0.80
0.60
0.40
0.20
0.10
0.05
.01
0

8173
4W20,000A
RADIAL-BEAM POWER TETRODE

The Eimac 8173/4W20,000A is a high-power, water-cooled transmitting tetrode having a maximum plate dissipation rating of 20 kilowatts. This tube will operate efficiently as a power-amplifier at frequencies up to 250 Mc. A single 8173/4W20,000A operating as a television visual r-f amplifier will deliver a synchronizing power output of 26 kilowatts at 216 Mc., with a 5-Mc. bandwidth.

The coaxial terminal arrangement of the tube is ideally suited for use in cavity circuits. The cathode is a unipotential thoriated tungsten cylinder of rugged construction, heated by electron bombardment.



GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, thoriated tungsten. Heated by electron bombardment.	
DC Voltage	1300 to 1500 volts
DC Current	1.7 to 1.9 amperes
Filament: Thoriated Tungsten, Helical	
Voltage (See Page 2)	10 volts
Current (without cathode bombardment)	30 amperes
Current (with cathode bombardment)	25 amperes
Maximum allowable starting current	50 amperes
Direct Interelectrode Capacitances (Grounded-Grid)	
Plate-Cathode	0.4 to 0.6 $\mu\mu$f
Input	75 to 87 $\mu\mu$f
Output	21 to 25.5 $\mu\mu$f
Screen-Grid Amplification Factor (Average)	5.5
Transconductance (I_b=6.6 A.,E_b=3.0 kV., E_{c2}=1200 V.)	75,000 μmhos

MECHANICAL

Base	Special, Concentric
Mounting Position	Vertical, base down or up
Cooling	Water and Forced Air
Maximum Over-all Dimensions	
Length (Including Tubing)	15 inches
Diameter (Anode)	5.03 inches
Net Weight	7.6 pounds

RADIO FREQUENCY POWER AMPLIFIER MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	8 MAX. KV
DC PLATE CURRENT	15 MAX. AMP
PLATE DISSIPATION	20 MAX. KW
SCREEN DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	60 MAX. WATTS

TYPICAL OPERATION

Class-C Telegraphy or FM Telephony (Per tube—220 Mc.)

DC Plate Voltage	5000	6000	7000	volts
DC Screen Voltage	1200	1200	1200	volts
DC Grid Voltage	—350	—370	—400	volts
DC Plate Current	3.6	3.6	3.4	amps
DC Screen Current (approx.)*	167	167	167	ma
DC Grid Current (approx.)	50	50	50	ma
Peak RF Input Voltage	455	475	505	volts
Driving Power (approx.)*	750	780	830	watts
Screen Dissipation	200	200	200	watts
Plate Power Input	18	21.6	23.8	kw
Plate Dissipation	7.0	8.6	8.0	kw
Useful Power Output	9.2	11.5	13.0	kw

*The performance figures listed above are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power and output power allow for losses associated with practical resonant circuits.

TYPICAL OPERATION

Class-B Linear Amplifier—Television Visual Service
(Per tube, 5-Mc. Bandwidth up to 216 Mc.)

Peak Synchronizing Level		
Load Impedance	650	ohms
Effective Length of Plate Line	¼	wave
DC Plate Voltage	7000	volts
DC Screen Voltage	1200	volts
DC Control Grid Voltage	—150	volts
DC Plate Current	6.0	amps
DC Screen Current (approx.)	230	ma
DC Control Grid Current (approx.)	90	ma
Peak RF Grid Input Voltage	280	volts
Driving Power (approx.)	500	watts
Plate Power Input	42	kw
Plate Dissipation	16	kw
Useful Plate Power Output	26	kw
Black Level		
DC Plate Current	4.5	amps
DC Screen Current	100	ma
DC Control Grid Current (approx.)	45	ma
Peak RF Grid Input Voltage	220	volts
Driving Power (approx.)	300	watts
Plate Power Input	32	kw
Plate Dissipation	16.5	kw
Useful Power Output	15.5	kw

These 216 Mc. typical performance figures were obtained by direct measurement in test equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant grid circuit. These figures are subject to variation and in many cases, with further refinement and improved techniques, better performance might be obtained.

▶ Indicates change from sheet dated 2-1-62.

(Effective 4-15-64) © Copyright 1962-1964 by Eitel-McCullough, Inc.

Note: Typical operation data are based on conditions of adjusting to a specificied plate current, maintaining fixed conditions of grid bias, screen voltage, suppressor voltage and r-f grid voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid, screen and suppressor currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

APPLICATION

Mounting—The 4W20,000A must be mounted vertically. Base-down or base-up mounting is optional.

The co-axial contact surfaces provided for connection to the filament, cathode, grid, screen, and anode are of successively larger diameters to facilitate removal and replacement of tubes.

Cavity circuits may be designed around the dimensions shown in the outline drawing. At very high frequencies the points of contact between the tube and the external circuit will be required to carry high values of charging current. It is, therefore, essential that the contactors make firm and uniform contact between the terminal surfaces of the tube and the external circuit. Particular care should be taken that the contactors are not inadvertently forced out of shape, and that all contact surfaces are maintained free from dust or other foreign matter which would prevent uniform electrical connection. At VHF, poor contact by one finger of a multi-finger collet can result in local overheating which may damage the tube seals.

Although contact fingers or slotted collets are often made an integral part of cavity circuits, there is some advantage to reversing the plan by providing contact-finger assemblies which are designed to be clamped firmly to the terminal surfaces of the tube itself and to make sliding contact with the cavity as the tube is inserted. This arrangement facilitates replacement of worn or damaged contactors and tends to remove incidental local heating from the vicinity of the tube seals. Tubes held in reserve for emergency replacement may be fitted with contact finger assemblies and water-line extensions to minimize lost time in making changes.

Cathode Heating Power — The cathode of the 4W20,000A is a unipotential, thoriated tungsten cylinder, heated by electron bombardment of its inner surface. Bombardment is obtained by using the cylindrical cathode as the anode of a diode. A helical filament is mounted on the axis of the cathode cylinder to supply the bombarding electrons. A d-c potential of approximately 1400 volts is applied between the filament and the cathode cylinder, and the recommended cathode heating power of 2500 watts is obtained with approximately 1.8 amperes.

The inner filament is designed to operate under space-charge limited conditions so that the cathode temperature may be varied by changing the voltage applied between the inner filament and the cathode cylinder.

For maximum tube life the filament voltage, as measured directly at the filament terminals, must be reduced after the cathode has reached operating temperature. The proper filament voltage for a given cathode bombardment power may be found in the table below. The filament voltage should remain at the 10.0-volt value until the cathode has reached operating temperature, an interval of approximately thirty seconds. The filament voltage should be maintained to within 5% of the proper operating value and the cathode bombardment power should be held within plus or minus 100 watts of the recommended value.

Cathode Bombardment Power	2000	2250	2500	2750	3000
Filament Voltage	6.0	5.2	4.3	3.2	2.0

A cathode bombardment power of 2250 watts is normal for average CW conditions. In applications requiring peak values of cathode current in excess of 75 amperes the cathode bombardment power may be increased to a value between 2250 and 3000 watts as required.

Further increases in cathode efficiency will result in a decrease in the cathode bombardment power requirements. The cathode bombardment power supply should, therefore, be capable of providing a minimum of approximately 2000 watts.

Caution: It must be kept in mind that the filament is at a potential of 1400 volts d-c with respect to ground. The filament transformer and voltmeter must be adequately insulated for this voltage.

Grid Voltage Regulation—The practice of designing grid voltage supplies to maintain adequate regulation under conditions of varying grid current is particularly desirable with the 4W20,000A. Because the cathode of the 4W20,000A is a complete cylinder, grid temperatures run higher than usual. For this reason, even with no excitation, control grid current reversal might conceivably be several milliamperes and safe design should allow for possible peaks on the order of 100 milliamperes.

Anode Cooling—The water-cooled anode requires 8 gallons per minute of cooling water for the rated 20 kilowatts of plate dissipation. This corresponds to a pressure drop of 7 pounds per square inch across the water jacket. The inlet water pressure must not exceed a maximum of 50 pounds per square inch.

The outlet water temperature must not exceed a maximum of 70°C under any conditions.

Seal Cooling—The grid and screen tube contact surfaces and adjacent glass and ceramic must be cooled by high-velocity air which may be accomplished by means of ring manifolds. The quantity, velocity and direction of air must be adjusted to limit the maximum seal temperatures to 150°C.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

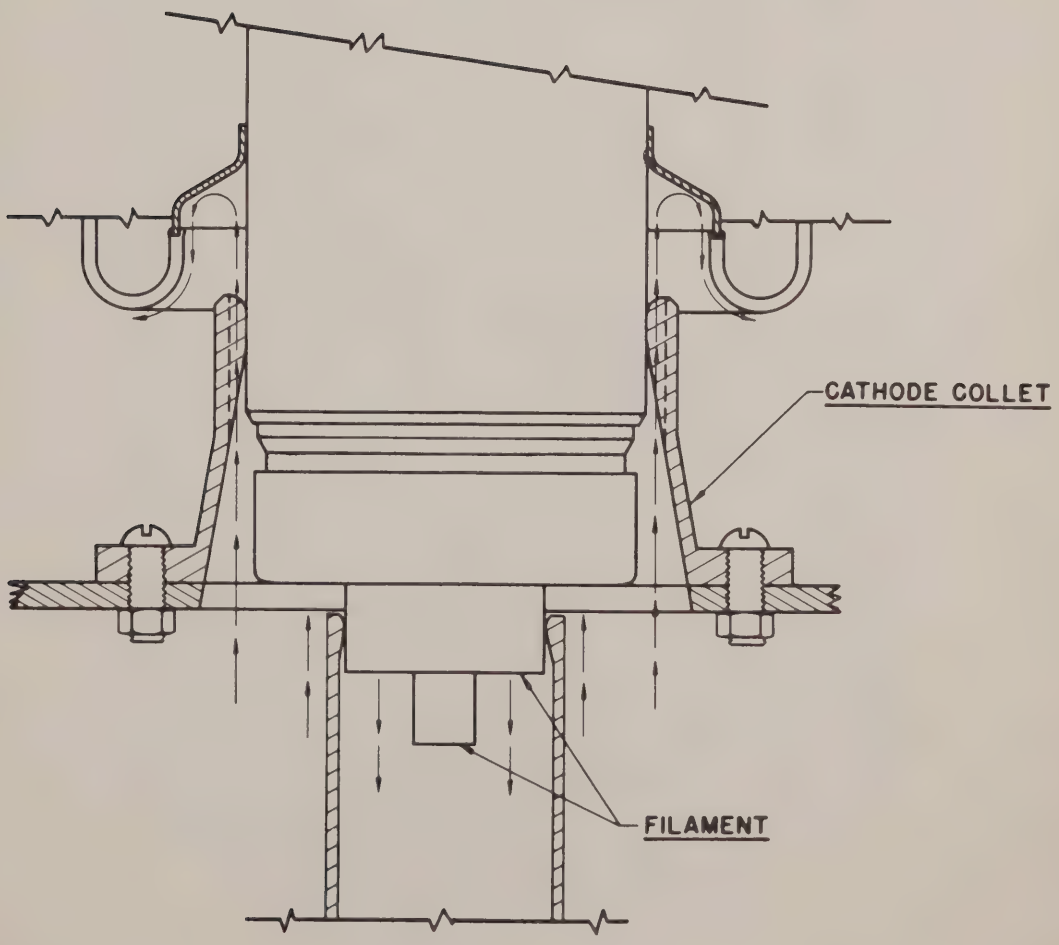
The cathode and filament stem also require forced-air cooling in sufficient quantity so that the region on the cathode terminal opposite the glass of the grid terminal seal does not exceed a maximum of 150°C. The major portion of this air must be guided along the surface of the terminal sleeve. The remaining air flows through the nine holes inside the terminal sleeve, cools the filament stem and vents through the three holes in the tube base enclosed by the outer filament spring collet connection.

By employing a cathode collet such as is shown in the accompanying drawings, the recommended cooling requirements will be fulfilled with an air flow of 60 cubic feet per minute at a static manifold pressure of 2 inches of water column.

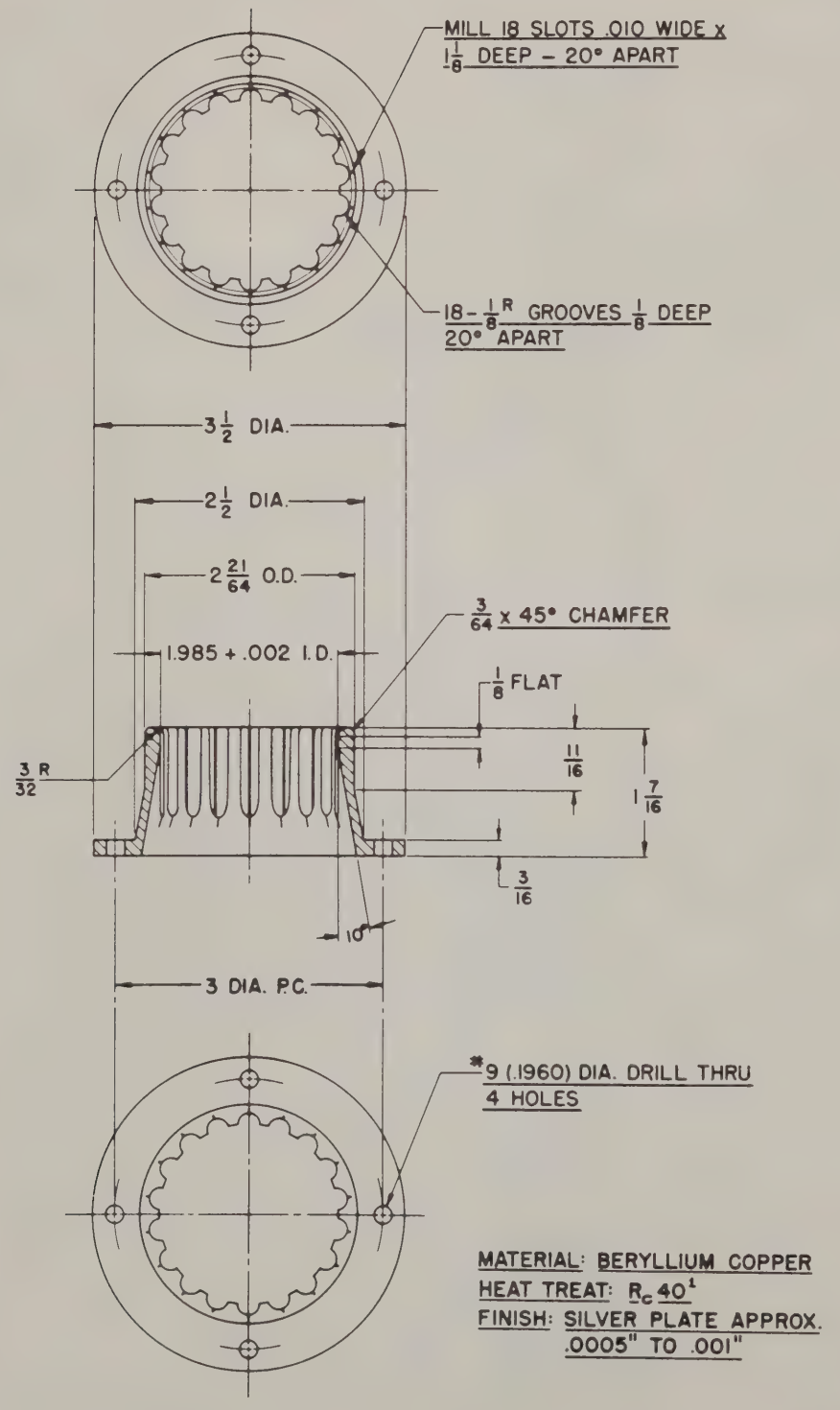
Air and water flow must be started before filament and cathode power are applied and maintained for at least two minutes after the filament and cathode power have been removed.

4W20,000A

SUGGESTED STEM AIR COOLING

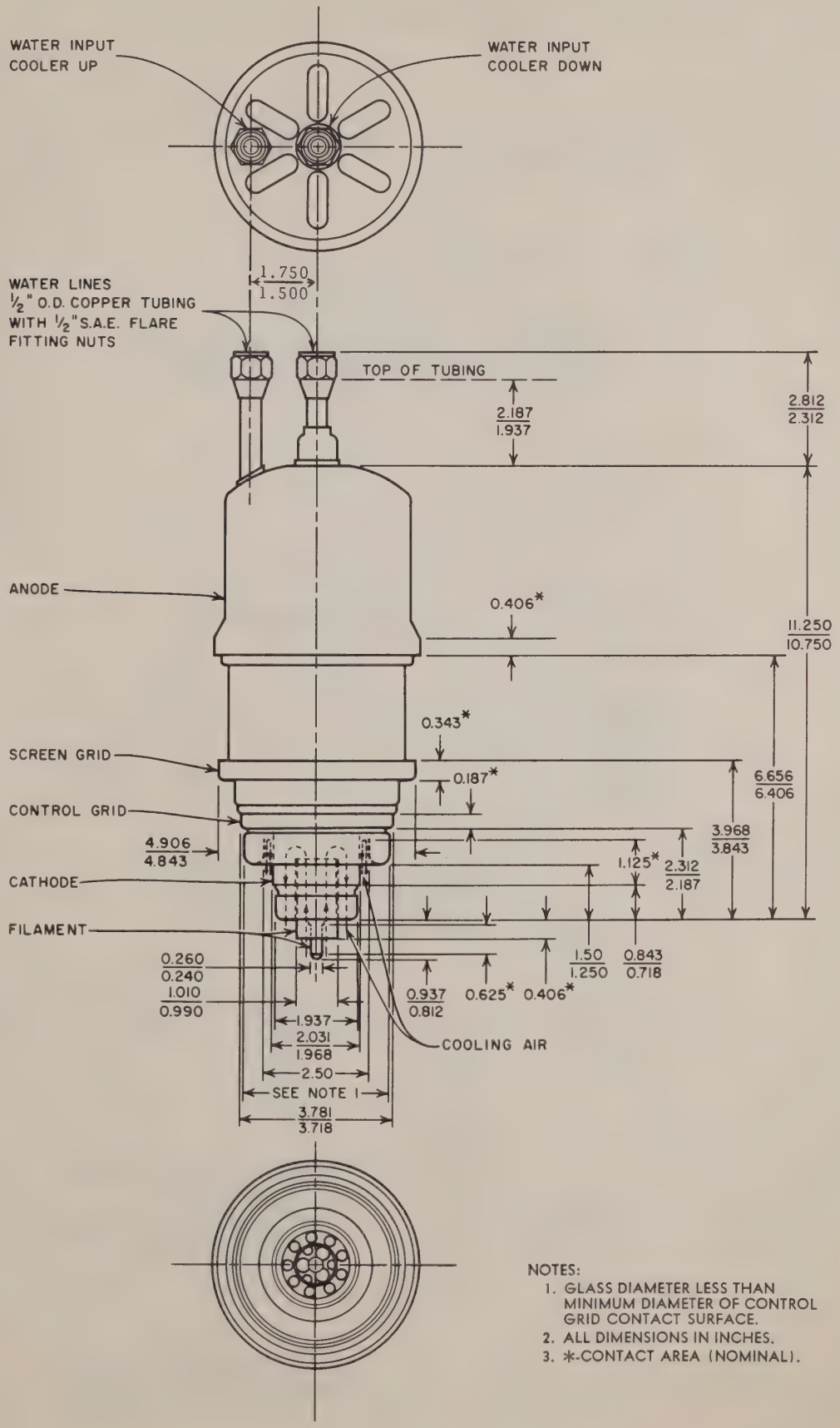


4W20,000A
CATHODE COLLET

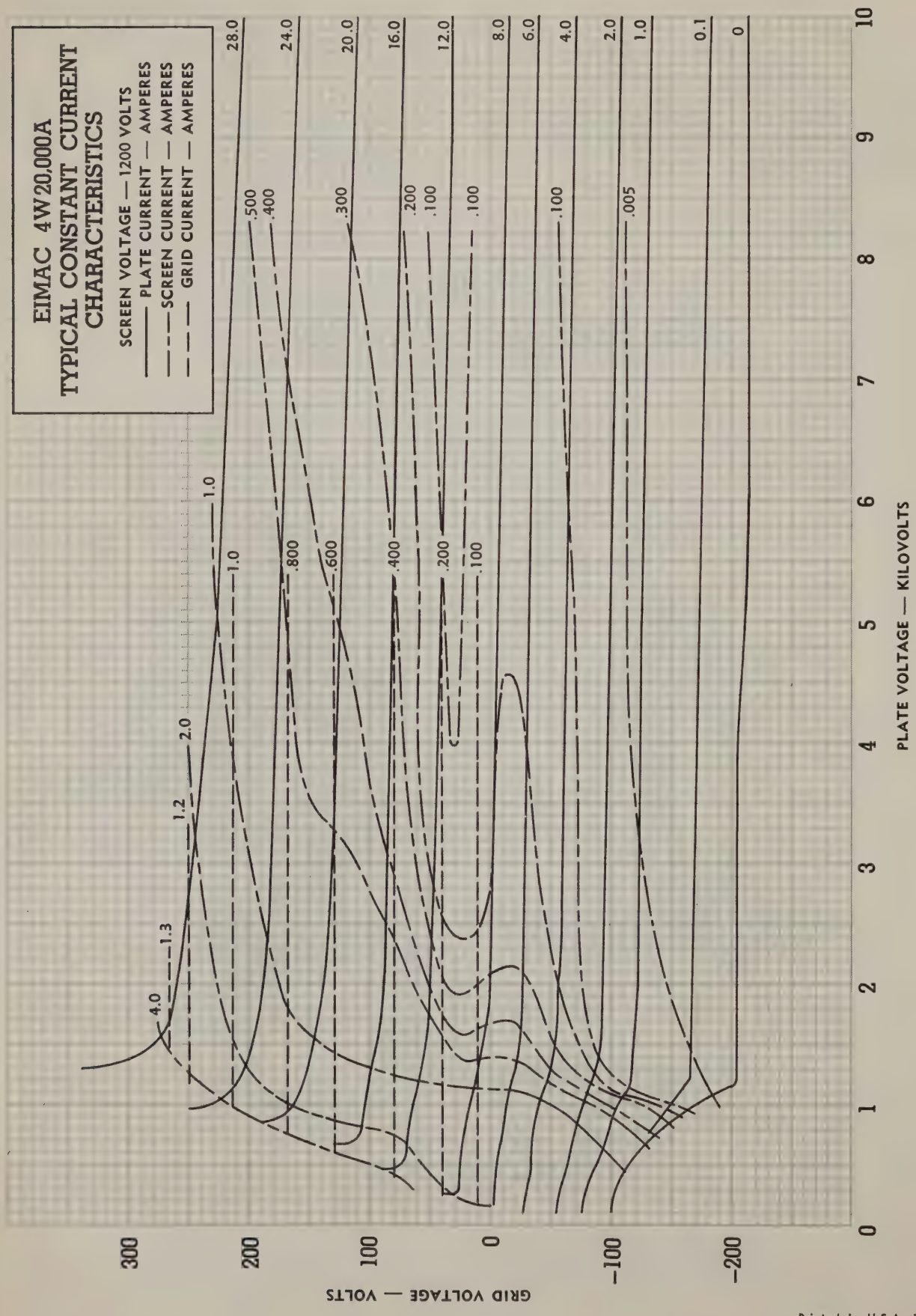


MATERIAL: BERYLLIUM COPPER
HEAT TREAT: R_C 40[1]
FINISH: SILVER PLATE APPROX. .0005" TO .001"

[1] 385°C FOR APPROX. 5–6 HRS. IN NON-REDUCING ATMOSPHERE



NOTES:
1. GLASS DIAMETER LESS THAN MINIMUM DIAMETER OF CONTROL GRID CONTACT SURFACE.
2. ALL DIMENSIONS IN INCHES.
3. *-CONTACT AREA (NOMINAL).



Printed in U.S.A. 194A

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

(Revised 4-15-78)

Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 4-15-78
Index 4-15-78
EIMAC and JEDEC Cross Reference List 4-15-78
Power Grid Selection Guide 2-15-75
Varian/Eimac Electron Tube and Device Group Sales Offices 3-15-78
Distributor Directory 3-15-78

DIODES - RECTIFIERS

2-01C 1-22-60
2-450A 3-1-66
250R 12-15-65
253 7-1-52

PLANAR TRIODES

2C39A ..... see 7289
3CX100A5 ..... see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 ..... see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R ..... see 7815
7815RAL ..... see 7815AL
7855/7855K 8-1-71
7855K ..... see 7855
7855KAL 3-1-72
8403 12-1-71
8533 12-1-71
8755 3-31-78
8757 3-3-70
8847A 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 ..... see 8906
8933 11-15-72
8940 10-15-75
8941/Y690 10-15-75
Y572AL ..... see 8906AL
Y690 ..... see 8941

TRIODES

3-400Z/8163 6-1-77
3-500Z 6-1-77
3-1000Z/8164 8-15-74
3C24 11-1-51
3CPX1500A7 4-1-76
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A3/8242 1-11-74
3CW5000A7 7-1-76
3CW5000F1/8241 5-15-71
3CW5000F3/8243 ..... see 3CW5000A3
3CW5000F7 ..... see 3CW5000A7
3CW5000H3 4-1-66
3CW5000H7 8-1-76
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 8-1-75
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW20,000H7 5-15-74
3CW30,000H3 11-1-68
3CW30,000H7 2-1-75
3CW40,000H3 5-1-76
3CX400U7/8961 8-1-74
3CX1000A7/8283 3-25-75
3CX1500A7/8877 5-15-77
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 & 8162/3CX3000F7 10-1-75
3CX30000A7 10-1-75
3CX3000H7 5-15-76
3CX3000F1/8239 11-1-67
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
35T 2-1-69
100TH 4-1-67
100TL 5-1-52
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
5867A 11-15-64
8873/8874/8875 1-1-77
8938 5-15-73

TETRODES

4-65A/8165 5-1-62
4-125A/4D21 6-1-67
4-250A/5D22 5-5-70
4-400A/8438 7-20-70
4-400C/6775 4-1-71
4-500A 3-10-72

TETRODES

4-1000A/8166	10-30-66
4CN15A	6-1-68
4CPX250K/8590	5-1-76
4CS250R	9-1-70
4CV8000A	3-15-71
4CV35,000A	5-15-66
4CV50,000E	4-1-76
4CV50,000J	7-15-71
4CV100,000C/8351	2-1-68
4CV250,000A	3-1-72
4CW800B/F	11-1-73
4CW2000A/8244	6-15-71
4CW10,000A/8661	4-15-63
4CW25,000A	2-1-72
4CW50,000E	9-1-75
4CW50,000J	7-15-71
4CW100,000D	9-1-75
4CW100,000E	9-1-70
4CW250,000A	3-1-71
4CX125C/F	6-1-67
4CX250B/7203 & 4CX250FG/8621	8-1-74
4CX250BC/8957	1-1-74
4CX250K/8245 & 4CX250M/8246	5-1-68
4CX250R/7580W	6-16-61
4CX300A/8167	8-30-66
4CX300Y/8561	6-15-66
4CX350A/8321 & 4CX350F/8322	6-15-65
4CX350FJ/8904	9-1-71
4CX600B & 4CX600F	3-20-70
4CX600J/8809 & 4CX600JA/8921	8-15-71
4CX1000A/8168	5-1-70
4CX1000K/8352	8-20-66
4CX1500A	12-1-71
4CX1500B/8660	6-1-67
4CX3000A/8169	1-20-76
4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	5-1-76
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	9-1-75
4W300B/8249	11-1-73
4X150A/7034 & 7609	8-1-74
4X150G/8172	10-15-73
4X500A	1-1-64
6816, 6884, 7843	11-15-71
7609	see 4X150A/7034
8560A	7-15-71
8930	12-1-73
8954	6-1-74
8959	11-1-74
X2159	5-1-77

PENTODES

5-125B/4E27A	8-15-52
5-500A	5-1-68
5CX1500A	11-15-75
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

PULSE MODULATORS

4PR60C/8252W	6-30-71
4PR65A/8187	2-15-63
4PR125A/8247	3-15-64
4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

OTHER PRODUCTS

CV-850	3-1-78
VS-2, 4 & 6	9-1-75
Performed Contact Finger Stock	6-15-71
HR Heat Dissipating Connectors	12-1-65
SK-300A	3-15-78
SK-306, SK-316	3-1-76
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73
SK-410	12-1-73
SK-500	3-15-67
SK-506, SK-516	4-15-69
SK-510	3-15-75
SK-600A, SK-610A	11-1-74
SK-606, SK-626, SK-636, SK-646	11-1-74
SK-607	8-15-71
SK-620, SK-620A	7-1-75
SK-630, SK-630A	7-1-75
SK-640	7-1-75
SK-650, SK-655	5-1-76
SK-700, SK-710	5-1-76
SK-711A, SK-712A	3-15-71
SK-740	7-15-75
SK-760, SK-770	7-15-75
SK-800B, SK-806	4-9-64
SK-810B, SK-806	6-1-67
SK-816, SK-860, SK-870	3-25-75
SK-890B, SK-806	6-1-67
SK-900, SK-906	8-15-66
SK-1300, SK-1310, SK-1320	3-1-72
SK-1306, SK-1406	8-15-66
SK-1400A, SK-1470A	10-15-66
SK-2200, SK-2210, SK-2216	3-1-76



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

Revised 4-15-78

Printed in U.S.A.

100TH	T
100TL	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
2-01C	D
2-450A	R
2C39A see 7289	PL
35T	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CPX1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A3/8242	T
3CW5000A7	T
3CW5000F1/8241	T
3CW5000F7	T
3CW5000H3	T
3CW5000H7	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW20,000H7	T
3CW30,000H3	T
3CW30,000H7	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX400U7	T
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX3000H7	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203 & 4CX250FG/8621	TET
4CX250BC/8957	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4X150A7034 see 7609	TET
4X150G/8172	TET
4X500A	TET
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6C21	PM
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET
7211	PL
7289/3CX100A5	PL
7580W see 4CX250R	TET
7609 see 4X150A/7034	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7843	TET
7855/7855K	PL
7855KAL	PL
7855K see 7855	PL
869B	R
869BL see 869B	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8757	PL
8809 see 4CX600J	TET
8847A	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8877 see 3CX1500A7	T
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
8941/Y690	PL
8954	TET
8959	TET
Contact Finger Stock (Performed)	OP
CV-850	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-646 see SK-606	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-816	OP
SK-860 see SK-816	OP
SK-870 see SK-816	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
SK-2216 see SK-2210	OP
VS-2, 4, 5 & 6	OP
X-2159	TET
Y572AL see 8906AL	PL
Y-690 see 8941	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC CROSS-REFERENCE LIST

(Revised 4-15-78)

1973 Varian Associates

Printed in U.S.A.

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC to JEDEC

EIMAC No.	JEDEC No.
2-01C	—
2-50A	—
2-150D	—
2-240A	—
2C39A	2C39A
2C39WA	2C39WA
2X1000A	—
2X3000F	—
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	—
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CPX1500A7	—
3CV30,000AI	—
3CV30,000A3	—
3CV30,000H3	—
3CV50,000A7	—
3CW2000A7	—
3CW5000A3	8242
3CW5000A7	—
3CW5000F1	8241
3CW5000F3	8243
3CW5000F7	—
3CW5000H3	—
3CW5000H7	—
3CW10,000A3	—
3CW10,000H3	—
3CW20,000A1	—
3CW20,000A3	—
3CW20,000A7	—
3CW20,000H3	—
3CW20,000H7	—
3CW30,000H3	—
3CW30,000H7	—
3CW40,000H3	—
3CX100A5	7289
3CX100F5	8250
3CX400U7	8961
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	—
3CX3000A1	8238
3CX3000A7	—
3CX3000F1	8239
3CX3000F7	8162
3CX3000H7	—
3CX4500A3	—
3CX4500H3	—
3CX4500A7	—
3CX4500H7	—
3CX5000A3	—
3CX5000H3	—
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	—
3CX15,000A3	—
3CX15,000A7	—
3CX15,000H3	—
3CX20,000A3	—
3CX20,000A7	—
3CX20,000H3	—
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	—
4-1000A	8166
4CN15A	—
4CPX250K	8590
4CS250R	—
4CV8000A	—
4CV35,000A	—
4CV50,000E	—
4CV50,000J	—
4CV100,000C	8351
4CV250,000A	—
4CW800B	—
4CW800F	—
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	—
4CW50,000E	—
4CW50,000J	—
4CW100,000D	—
4CW100,000E	—
4CW250,000A	—
4CX125C	—
4CX125F	—
4CX250B	7203
4CX250BC	8957
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	—
4CX600F	—
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	—
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	—
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	—
4W300B	8249
4X150A	7034
4X150G	8172
4X500A	—
5-125B	4E27A
5-500A	—
5CX1500A	—
5CX3000A	8966
6C21	6C21
25T	25T
35T	35T
100TH	100TH
100TL	100TL
177A	—
177WA	6549W
250R	—
250TH	250TH
250TL	250TL
253	253
254W	—
264	8576
279	—
290A	—
294	—
304TH	304TH
304TL	304TL
322	—
450TH	450TH
450TL	450TL
826	826
4631	—
5867A	5867A
6155	6155
6156	6156
6549	6549
6775	6775
6816	6816
6884	6884
7211	7211
7457	7457
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8295A	8295A
8403	8403
8533W	8533W
8560A	8560A
8560AS	8560AS
8596	8596
8745	8745
8755	8755
8757	8757
8847A	8847A
8873	8873
8874	8874
8875	8875
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8959	8959
8960	8960
8964	8964
8965	8965
8971	8971
8972	8972
8973	8973
8974	8974
8980	8980

JEDEC/EIMAC CROSS-REFERENCE LIST

JEDEC to EIMAC

JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
100TH	100TH
100TL	100TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
592	3-200A3
826	826
5867A	5867A
6155	6155
6156	6156
6549W	177WA
6775	4-400C
6816	6816
6884	6884
7034	4X150A
7203	4CX250B
7211	7211
7289	3CX100A5
7457	7457
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8438	4-400A
8533W	8533W
8560A	8560A
8560AS	8560AS
8561	4CX300Y
8576	264
8590	4CPX250K
8596	8596
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8757	8757
8809	4CX600J
8847A	8847A
8873	8873
8874	8874
8875	8875
8877	3CX1500A7
8904	4CX350FJ
8906	8906
8906AL	8906AL
8907	8907
8909	4CX5000J
8910	4CX15,000J
8921	4CX600JA
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8957	4CX250BC
8959	8959
8960	8960
8961	3CX400U7
8964	8964
8965	8965
8966	5CX3000A
8971	8971
8972	8972
8973	8973
8974	8974
8980	8980

Varian Electron Device Group
Sales Office Locations

U.S. SALES OFFICES

Atlanta
6650 Powers Ferry Rd., N.W.
Suite 100
Atlanta, Georgia 30339
TEL: (404) 955-1397

Clearwater Branch
314 South Missouri
Suite 307
Clearwater, Florida 33516
TEL: (813) 446-8513

Warner Robins Branch
United Finance Bldg.,
Suite #4
1600 Watson Blvd.
Warner Robins, GA 31093
TEL: (912) 922-2202

Boston
400 Totten Pond Road
Bldg. #1
Waltham, Massachusetts 02154
TEL: (617) 890-4560

Chicago
205 W. Touhy Avenue
Park Ridge, Illinois 60068
TEL: (312) 825-6686

Dallas
P.O. Box 689
558 S. Central Expressway
Suite 202
Richardson, Texas 75080
TEL: (214) 235-2385

Dayton
4134 Linden Avenue
Suite 101
Dayton, Ohio 45432
TEL: (513) 258-3930

Los Angeles
2901 Wilshire Blvd.,
Suite 102
Santa Monica, Calif. 90403
TEL: (213) 828-5588

New York (Metropolitan)
25 Route 22
Springfield, New Jersey 07081
TEL: (201) 376-6600

Philadelphia
306 Fellowship Road
Mount Laurel, New Jersey
08054
TEL: (609) 235-6800

Phoenix
7117 Third Avenue,
Suite 107
Scottsdale, Arizona 85251
TEL: (602) 947-5461

San Francisco
375 Distel Circle
Los Altos, California 94022
TEL: (415) 968-7630

Syracuse
6489 Ridings Road
Syracuse, New York 13206
TEL: (315) 437-2568

Washington, D.C.
4701 Lydell Road
Cheverly, Maryland 20781
TEL: (301) 773-7010

INTERNATIONAL SALES OFFICES

Headquarters
Varian Export Corp.
611 Hansen Way
Palo Alto, CA 94303
TEL: (415) 493-4000

Australia
Varian Pty. Ltd.
781 Pacific Highway
Chatswood, N.S.W. 2067
Australia
TEL: 411-1277

Varian Pty. Ltd.
679 Springvale Road
North Springvale, VICT. 3171
Australia
TEL: 560-7133

Benelux
Varian Benelux B.V.'s
Maassluisstraat 100
P.O. Box 9158
Amsterdam, Holland
TEL: (020) 15 94 10

Varian Benelux SA/NV
Avenue Charles Quint 545
1080 Brussels, Belgium
TEL: 02/66-20-00

Brazil
Varian Indústria e Comércio Ltda.
Avenida DR Cardoso De Melo, 1644
V. Olimpia
Caixa Postal 19010-Pinheiros
04548 Sao Paulo, Brazil
TEL: 240-1622

Canada
Varian Associates of Canada Ltd.
45 River Drive
Georgetown, Ontario, Canada L7G 2J4
TEL: (416) 457-4130

France
Varian S.A.
Quartier de Courtaboeuf
Boite Postale No. 12
91401 Orsay
France
TEL: 907.78.26

Germany
Varian GmbH
Allacher Strasse 230E
D-8 München 50, West Germany
TEL: (089) 81 26 093

Italy
Varian SpA
Via Fratelli Varian
1-10040 Leini (Torino)
Italy
TEL: (011) 996 80 86

Japan
Marubun Corporation
1-1, Nihombashi
Odemmacho 2-Chome
Chuo-Ku, Tokyo, 103 Japan
TEL: (03) 662-8151

Scandinavia
Varian AB
Skytteholmsvagen 7D
P.O. Box 1099
S-171 22 Solna 1, Sweden
TEL: (08) 82 00 30

Switzerland
Varian A.G.
Grienbachstrasse 17
Postfach
6300 Zug, Switzerland
TEL: (042) 31 66 55

United Kingdom and Ireland
EMI-Varian Ltd.
Blyth Road
Hayes
Middlesex
England
TEL: 01-573-5555

varian

FRANCHISED DISTRIBUTORS

3/15/78

Power Grid Tubes and Related Products



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

POWER GRID ELECTRON TUBES AND RELATED PRODUCTS

EIMAC DIVISION, 301 Industrial Way, San Carlos, California 94070, Tel: (415) 592-1221

NORTHEAST REGION

Industrial Components Corporation
2551 Boston Road
North Wilbraham, MA 01095
(413) 596-3854

A. W. Mayer Company, Inc.
38 Border Street
West Newton, MA 02165
(617) 965-1111

R&S Electronic Distributors, Inc.
95 Leggett Street
East Hartford, CT 06108
(203) 528-9901

Summit Distributors, Inc.
916 Main Street
Buffalo, NY 14202
(716) 884-3450

ATLANTIC REGION

Allegheny Electronics, Inc.
800 Chestnut Avenue
Altoona, PA 16601
(814) 946-0871

Argil Electronics, Ltd.
50 West 17 Street
New York, NY 10011
(212) 691-8111

Barry Electronics Corp.
512 Broadway
New York, NY 10012
(212) 925-7000

Calvert Electronics International Inc.
220 East 23 Street
New York, NY 10010
(212) 679-1340

CAM/RPC Industrial Electronics
620 Alpha Drive
Pittsburg, PA 15238
(412) 782-3770

Ceco Communications, Inc.
2115 Avenue X
Brooklyn, NY 11235
(212) 646-6300

I.S. Electronics, Inc.
3178 Nostrand Avenue
Brooklyn, NY 11229
(212) 336-7637

Midway Industrial Electronics, Inc.
24 Maple Avenue
Rockville Center, NY 11571
(516) 764-2400

Philadelphia Electronics, Inc.
112 North 12 Street
Philadelphia, PA 19107
(215) 568-7400

State Labs, Inc.
215 Park Avenue South
New York, NY 10003
(212) 677-8400

Val-Tronics, Inc.
Penn Park Bldg.
Pittston, PA 18640
(717) 655-5937

SOUTHEAST REGION

ACK Radio Supply Co. of Georgia
554 Deering Road, N.W.
Atlanta, GA 30309
(404) 351-6340

ACK Radio Supply Co.
3101 - 4th Avenue South
Birmingham, AL 35233
(205) 322-0588

Capitol Radio Wholesalers, Inc.
12270 Wilkins Avenue
Rockville, MD 20852
(301) 881-2270

James W. Clary Company, Inc.
1713 Second Avenue South
Birmingham, AL 35233
(205) 322-2488

Collins Brothers Electronics, Inc.
4946 Marlboro Pike
Washington, DC 20027
(301) 420-4400

Dixie Radio Supply Co., Inc.
1900 Barnwell Street
Columbia, SC 29201
(803) 235-5333

Electronic Equipment Company, Inc.
4027 N.W. 24 Street
Miami, FL 33142
(305) 871-3500

Hammond Electronics, Inc.
2923 Pacific Avenue
P.O. Box 21728
Greensboro, NC 27406
(919) 275-6391

Hammond Electronics, Inc.
1230 West Central Blvd.
Orlando, FL 32805
(305) 849-6060

Hammond Electronics
1516 Cypress Street
Tampa, FL 33606
(813) 253-0104

Southeast Electronics, Inc.
1125 Rosselle Street
Jacksonville, FL 32203
(904) 356-3007

Southeastern Radio Supply Co., Inc.
414 Hillsboro Street
Raleigh, NC 27603
(919) 828-2311

Specialty Distributing Co., Inc.
763 Juniper Street, N.E.
Atlanta, GA 30308
(404) 873-2521

NORTH CENTRAL REGION

Amateur Electronics Supply, Inc.
4828 W. Fon du Lac Avenue
Milwaukee, WI 53216
(414) 276-4160

P.I. Burks Company, Inc.
842 South 7 Street
Louisville, KY 40203
(502) 589-3960

Deeco, Inc.
2500 - 16 Avenue, SW
Cedar Rapids, IA 52406
(319) 365-7551

Electra Distributing Co.
1914 West End Avenue
Nashville, TN 37203
(615) 329-3971

Electronic Center, Inc.
127 - 3rd Avenue, North
Minneapolis, MN 55401
(612) 338-5881

Graham Electronics Supply, Inc.
133 South Pennsylvania Street
Indianapolis, IN 46204
(317) 634-8486

NORTH CENTRAL REGION (continued)

Hughes-Peters, Inc.
4865 Duck Creek Road
Cincinnati, OH 45227
(513) 351-2000

Hughes-Peters, Inc.
481 E. 11 Avenue
Columbus, OH 43211
(614) 294-5351

Newark Electronics Corp.
500 North Pulaski Road
Chicago, IL 60624
(312) 638-4411

Olive Electronics, Inc.
6662 Olive Blvd.
St. Louis, MO 63130
(314) 863-7800

Radio Equipment Company
625 North 18 Street
Omaha, NB 68102
(402) 341-7709

Richardson Electronics, Ltd.
3030 North River Road
Franklin Park, IL 60131
(312) 456-0600

S/S Electronics, Inc.
503 North 7 Street
Fargo, ND 58102
(701) 237-5003

Scott Electronic Supply Corp.
4040 Adams Street
Lincoln, NB 68504
(402) 434-8308

Shand Electronics, Inc.
2401 S. Dort Highway
Flint, MI 48507
(313) 743-8940

Stotts-Friedman Co.
2600 East River Road
Dayton, OH 45439
(513) 298-5555

United Radio, Inc.
Summit Road & Reinhold Drive
Cincinnati, OH 45237
(513) 761-4030

SOUTHWEST REGION

Ballard Supply Corporation
2430 South 900 West
Salt Lake City, UT 84119
(801) 486-3081

Bibbins & Rice Electronics, Inc.
1008 Clothilde Street
Morgan City, LA 70380
(504) 384-2456

Broadcast Systems Company
Box 3536
Albuquerque, NM 87110
(505) 298-3510

Carlton-Bates Co.
Box 9649
Little Rock, AR 72209
(501) 562-9100

Dalis Electronic Supply
917 North 7 Street
Phoenix, AZ 85006
(602) 258-8151

Fistell's Electronic Supply Co.
1001 Bannock Street
Denver, CO 80204
(303) 623-7864

Guarantee Radio Supply Corp.
1314 Iturbide Street
Laredo, TX 98040
(512) 723-9422

Henry Radio Company
211 North Main Street
Butler, MO 64730
(816) 679-3127

Newark-Denver Electronic Supply Corp.
2170 South Grape Street
Denver, CO 80222
(303) 757-3351

Nunn Electric Supply Corp. of West Texas
119 Polk Street
Amarillo, TX 79105
(806) 376-4581

Nunn Electric Supply Corp. of West Texas
1817 - 4 Street
Lubbock, TX 79408
(806) 765-5741

Pueblo Walker Electronics
100 North Victoria
Pueblo, CO 81003
(303) 542-1924

Radio Parts, Inc.
1331 Prytania Street
New Orleans, LA 70130
(504) 581-5959

Radio Supply, Inc.
724 North Hudson Street
Oklahoma City, OK 73102
(405) 232-6128

Ralph's of Lafayette, Inc.
3004 Cameron
Lafayette, LA 70501
(318) 234-4507

Sherman Electronics Supply, Inc.
702 San Pedro Avenue
San Antonio, TX 78212
(512) 224-1001

Southern Radio Supply Co., Inc.
1909 Tulane Avenue
New Orleans, LA 70112
(504) 524-2345

Standard Supply Company
3424 South Main Street
Salt Lake City, UT 84110
(801) 486-3371

Sterling Electronics, Inc.
4201 Southwest Freeway
Houston, TX 77001
(713) 623-6600

Walker Radio Company, Inc.
102 Granite Avenue, N.W.
Albuquerque, NM 87125
(505) 247-2288

Walters Radio Supply Co.
3635 Main Street
Kansas City, MO 64111
(816) 531-7015

Wholesale Electronic Supply, Inc.
2809 Ross Avenue
Dallas, TX 75201
(214) 824-3001

Wicks Radio Equipment Co.
513-515 South Staples Street
Corpus Christi, TX 78401
(512) 884-8285

PACIFIC REGION

Abacus Electronics, Co., Inc.
1065 Terra Bella Avenue
Mountain View, CA 94040
(415) 961-1500

Brill Electronics
610 East 10 Street
Oakland, CA 94606
(415) 834-5888

Broadcast Services, Inc.
2877 Kalakaua Avenue
Honolulu, HI 96815
(808) 533-3877

California Tube Labs
1305 - 17th Avenue
Santa Cruz, CA 95062
(408) 475-2939

Dunlap Electronics
915 North B Street
Sacramento, CA 95814
(916) 444-8070

Electrical Equipment Co., Ltd.
832 Queen Street
Honolulu, HI 96813
(808) 533-3884

Ham Radio Outlet
999 Howard Avenue
Burlingame, CA 94010
(415) 342-5757

Henry Radio, Inc.
11240 W. Olympic Blvd.
Los Angeles, CA 90064
(213) 477-6701

Honolulu Electronics
819 Keeaumoku Street
Honolulu, HI 96814
(808) 949-5564

JSH Electronics, Inc.
8549 Higuera Street
Culver City, CA 90230
(213) 559-6900

Northwest Electronics, Inc.
730 East First Avenue
Spokane, WA 99220
(509) 534-2644

Robert E. Priebe Company
2211 Fifth Avenue
Seattle, WA 98121
(206) 682-8242

RPS Electronics, Inc.
1501 South Hill Street
Los Angeles, CA 90015
(213) 748-1271

United Electronics Wholesale
328 - 3rd Street, East
Twin Falls, ID 83301
(208) 733-7324

United Radio Supply, Inc.
123 N.E. 7 Avenue
Portland, OR 97232
(503) 233-7151

Western Radio & TV Supply Co.
1415 India Street
San Diego, CA 92101
(714) 239-0361

Yukon Radio Supply Company
3222 Commercial Drive
Anchorage, AK 99504
(907) 277-7117

Zack Radio Supply Co.
1444 Market Street
San Francisco, CA 94102
(415) 626-1444

ALPHABETIC LISTING

Abacus Electronics Co., Inc., 1065 Terra Bella Avenue, Mountain View, California 94040
ACK Radio Supply Co. of Georgia, 554 Deering Road, N.W., Atlanta, Georgia 30309
ACK Radio Supply Co., 3101 - 4th Avenue South, Birmingham, Alabama 35233
Allegheny Electronics, Inc., 800 Chestnut Avenue, Altoona, Pennsylvania 16601
Amateur Electronic Supply, 4828 West Fon du Lac Avenue, Milwaukee, Wiconsin 53216
Argil Electronics, Ltd., 50 West 17th Street, New York, New York 10011
Avmar Electronics International Co., 345 Commercial Avenue, Palisades Park, New Jersey 07650

Ballard Supply Corp., 2430 South 900 West, Salt Lake City, Utah 84119
Barry Electronics Corp., 512 Broadway, New York, New York 10012
Bibbins & Rice Electronics, Inc., 1008 Clothilde Street, Morgan City, Louisiana 70380
Brill Electronics, 610 East 10th Street, Oakland, California 94606
Broadcast Services, Inc., 2877 Kalakaua Avenue, Honolulu, Hawaii 96815
Broadcast Systems Co., Box 3536, Albuquerque, New Mexico 87110
P.I. Burks & Co., Inc., 842 South 7th Street, Louisville, Kentucky 40203

California Tube Labs, 1305 - 17th Avenue, Santa Cruz, California 95062
Calvert Electronics International, Inc., 220 E. 23rd Street, New York, New York 10010
CAM/RPC Industrial Electronics, 620 Alpha Drive, Pittsburg, Pennsylvania 15238
Capitol Radio Wholesalers, Inc., 12270 Wilkins Avenue, Rockville, Maryland 20852
Carlton-Bates Co., Box 9649, Little Rock, Arkansas 72209
Ceco Communications, Inc., 2115 Avenue X, Brooklyn, New York 11235
James W. Clary Co., Inc., 1713 Second Avenue South, Birmingham, Alabama 35233
Collins Brothers Electronics, Inc., 4946 Marlboro Pike, Washington, District of Columbia 20027

Dalis Electronic Supply, 917 North 7th Street, Phoenix, Arizona 85006
Deeco, Inc., 2500 - 16th Avenue, SW, Cedar Rapids, Iowa 52406
Dixie Radio Supply Co., Inc., 1900 Barnwell Street, Columbia, South Carolina 29201
Dunlap Electronics, 915 North "B" Street, Sacramento, California 95814

Electra Distributing Co., 1914 West End Avenue, Nashville, Tennessee 37203
Electrical Equipment Co., Ltd., 832 Queen Street, Honolulu, Hawaii 96813
Electronic Center, 127 - 3rd Avenue North, Minneapolis, Minnesota 55401
Electronic Equipment Co., Inc., 4027 N.W. 24th Street, Miami, Florida 33142

Fistell's Electronic Supply Co., 1001 Bannock Street, Denver, Colorado 80204

Graham Electronics Supply, Inc., 133 South Pennsylvania Street, Indianapolis, Indiana 46204
Guarantee Radio Supply Co., 1314 Iturbide Street, Laredo, Texas 98040

Ham Radio Outlet, 999 Howard Avenue, Burlingame, California 94010
Hammond Electronics, Inc., 2923 Pacific Avenue, P.O. Box 2178, Greensboro, North Carolina 27406
Hammond Electronics, Inc., 1230 West Central Blvd., Orlando, Florida 32802
Hammond Electronics, Inc., 1516 Cypress Street, Tampa, Florida 33606
Henry Radio, Inc., 11240 W. Olympic Blvd., Los Angeles, California 90064
Henry Radio Company, 211 North Main Street, Butler, Missouri 64730
Honolulu Electronics, 819 Keeaumoku Street, Honolulu, Hawaii 96814
Hughes-Peters, Inc., 4865 Duck Creek Road, Cincinnati, Ohio 45227
Hughes-Peters, Inc., 481 East 11th Avenue, Columbus, Ohio 43211

Industrial Components Corp., 2551 Boston Road, North Wilbraham, Massachusetts 01095
I.S. Electronics, Inc., 3178 Nostrand Avenue, Brooklyn, NY 11229

JSH Electronics, 8549 Higuera Street, Culver City, California 90230

A. W. Mayer Co., Inc., 38 Border Street, West Newton, Massachusetts 02165
Midway Industrial Electronics, Inc., 24 Maple Avenue, Rockville Center, New York 11571

Newark-Denver Electronic Supply Corp., 2170 South Grape Street, Denver, Colorado 80222
Newark Electronics Corp., 500 North Pulaski Road, Chicago, Illinois 60624
Newport Marine Engineering, 507 Superior Avenue, Newport Beach, California 92660
Northwest Electronics, Inc., 730 East First Avenue, Spokane, Washington 99220
Nunn Electric Supply Corp. of West Texas, 119 Polk Street, Amarillo, Texas 79105
Nunn Electric Supply Corp. of West Texas, 1817 - 4th Street, Lubbock, Texas 79408

ALPHABETIC LISTING (cont.)

Olive Electronics, Inc., 6662 Olive Blvd., St. Louis, Missouri 63130

Philadelphia Electronics, Inc., 112 North 12th Street, Philadelphia, Pennsylvania 19107
Robert E. Priebe Company, 2211 Fifth Avenue, Seattle, Washington 98121
Pueblo Walker Electronics, 100 North Victoria, Pueblo, Colorado 81003

Radio Equipment Company, 625 North 18th Street, Omaha, Nebraska 68102
Radio Parts, Inc., 1331 Prytania Street, New Orleans, Louisiana 70130
Radio Supply, Inc., 724 North Hudson Street, Oklahoma City, Oklahoma 73102
Ralph's of Lafayette, Inc., 3004 Cameron, Lafayette, Louisiana 70501
Richardson Electronics, Ltd., 3030 North River Road, Franklin Park, Illinois 60131
RPS Electronics, Inc., 1501 South Hill Street, Los Angeles, California 90015
R&S Electronic Distributors, Inc., 95 Leggett Street, East Hartford, Connecticut 06108

Scott Electronic Supply Corp., 4040 Adams Street, Lincoln, Nebraska 68504
Shand Electronics, Inc., 2401 S. Dort Highway, Flint, Michigan 48507
Sherman Electronics Supply, Inc., 702 San Pedro Avenue, San Antonio, Texas 78212
Southeast Electronics, Inc., 1125 Rosselle Street, Jacksonville, Florida 32203
Southeastern Radio Supply Co., Inc., 414 Hillsboro Street, Raleigh, North Carolina 27603
Southern Radio Supply Co., Inc. 1909 Tulane Avenue, New Orleans, Louisiana 70112
Specialty Distributing Co., Inc., 763 Juniper Street, N.E., Atlanta, Georgia 30308
S/S Electronics, Inc., 503 North 7th Street, Fargo, North Dakota 58102
Standard Supply Company, 3424 South Main Street, Salt Lake City, Utah 84110
State Labs, Inc., 215 Park Avenue South, New York, New York 10003
Sterling Electronics, Inc., 4201 Southwest Freeway, Houston, Texas 77001
Stotts-Friedman Co., 2600 East River Road, Dayton, Ohio 45439
Summit Distributors, Inc., 916 Main Street, Buffalo, New York 14202

United Electronics Wholesale, 328 - 3rd Street, East, Twin Falls, Idaho 83301
United Radio, Inc., Summit Road & Reinhold Drive, Cincinnati, Ohio 45237
United Radio Supply, Inc., 123 N.E. 7th Avenue, Portland, Oregon 97232

Val-Tronics, Inc., Penn Park Bldg., Pittston, Pennsylvania 18640

Walker Radio Company, Inc., 102 Granite Avenue, N.W., Albuquerque, New Mexico 87125
Walters Radio Supply Co., 3635 Main Street, Kansas City, Missouri 64111
Western Radio & TV Supply Co., 1415 India Street, San Diego, California 92101
Wholesale Electronic Supply, Inc., 2809 Ross Avenue, Dallas, Texas 75201
Wicks Radio Equipment Co., 513-515 South Staples Street, Corpus Christi, Texas 78401

Yukon Radio Supply Company, 3222 Commercial Drive, Anchorage, Alaska 99504

Zack Radio Supply Co., 1444 Market Street, San Francisco, California 94102

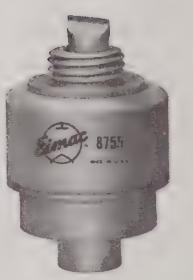
TECHNICAL DATA

8755

HIGH-MU
PLANAR TRIODE

The 8755 is a miniature, ceramic/metal, rugged planar triode for advanced airborne and space applications up to 3.0 GHz.

The 8755 may be used as an amplifier, oscillator, or frequency multiplier in the grid- or plate-pulsed mode, as well as a modulator or regulator tube. In addition to low interelectrode capacitances, high transconductance and amplification factor, the 8755 has an anode designed to produce frequency stability, and an arc-resistant cathode, both assuring stable, reliable and long-life operation under adverse conditions.



The 8755 is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced-air cooling, permitting an anode dissipation up to 150 watts, can be furnished on separate order.

The 8755 is especially designed for applications where high rf pulse power is required. It can also be readily used in switch tube applications up to 8 kV dc.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b = 160 mA (200 mA/cm^2)	38	mmhos
Amplification Factor (Average):	135	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Cgk	9.5	pF
Cpk	0.06	pF
Cgp	1.05	pF
Cut-off Bias[3]	-20	V max.

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the results of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Revised 3-31-78) © by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.37 in; 34.75 mm
Diameter	0.785 in; 19.94 mm
Net Weight	0.56 oz; 16 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction, convection, forced-air[1] or liquid
Terminals	Coaxial, special

1. Using one of the EIMAC radiators shown on the cooling curves.

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	70,000 ft.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (GRID PULSED)	8000	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	10,000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	150	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.0	GIGAHERTZ
PULSE DURATION[2]	6	μsec
DUTY FACTOR[2]	.0033	

TYPICAL OPERATION
Grid-Pulsed rf Power Amplifier (1182 MHz)

DC Plate Voltage	1750	Vdc
Peak Plate Current	1.0	a
DC Grid Voltage Approx.	-20	V
Peak Grid Current	1.7	a
Filament Voltage	5.6	V
Useful Power Output (Approx.)	650	w
Plate Efficiency	37%	
RF Input Power	65	w
Gain	10	db

1. Using one of the EIMAC radiators shown on the cooling curves.
2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	8000	VOLTS
PEAK PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION[2]	6	μs
DUTY FACTOR[2]	.0033	
CUT-OFF MU	90	

1. Using one of the EIMAC radiators shown on the cooling curves.
2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager EIMAC Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances [1] (grounded cathode connection)			
Cgk	8.5	10.5	pF
Cpk	---	0.06	pF
Cgp	0.9	1.2	pF

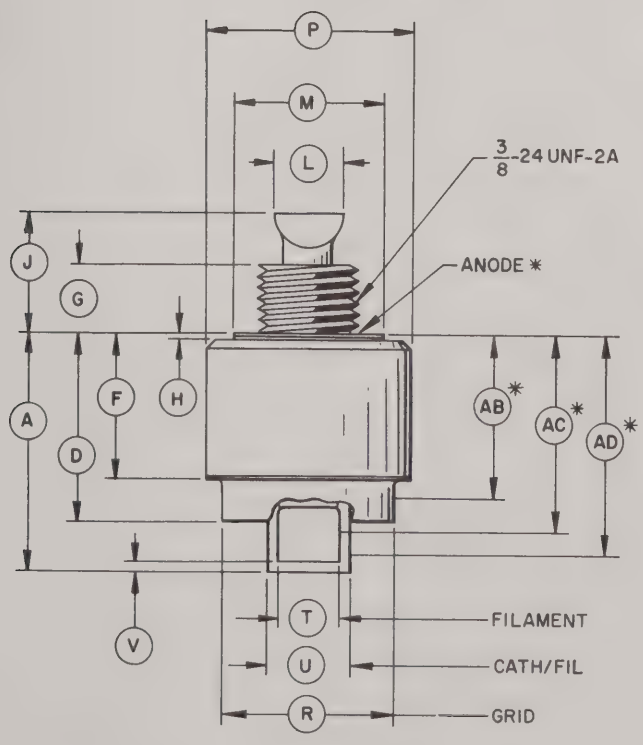
1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

APPLICATION

COOLING - The 8755 can be cooled by conduction, convection, forced-air or liquid cooling. The tube is designed to permit high temperature operation up to the limit indicated. However, if long life is the prime objective, tube terminal and seal temperatures should be kept well below 250°C. If forced-air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals.

Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C. Cooling curves are given for the three radiators which are suitable for use with the 8755.

For further details on cooling or other aspects of tube operation, refer to EIMAC bulletin #15, "Operating Data for Planar Triodes."



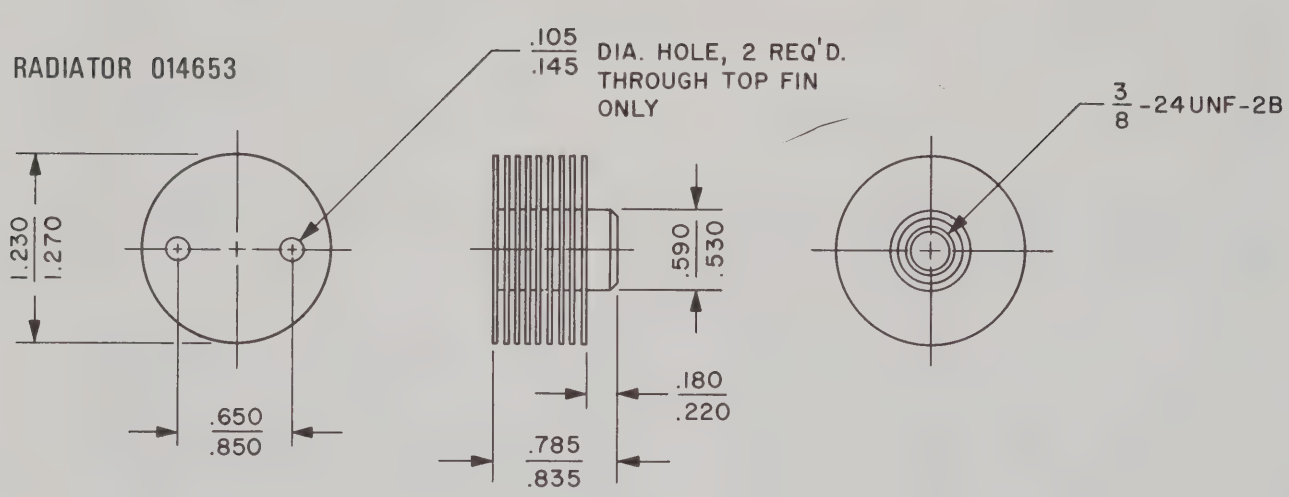
DIM.	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	1.020	- -	- -	25.91	- -
D	0.740	0.800	- -	18.80	20.32	- -
F	- -	0.570	- -	- -	14.48	- -
G	0.150	0.170	- -	3.81	4.32	- -
H	- -	0.040	- -	- -	1.02	- -
J	- -	0.350	- -	- -	8.89	- -
L	- -	0.260	- -	- -	6.60	- -
M	0.545	0.570	- -	13.84	14.48	- -
P	0.775	0.785	- -	19.69	19.94	- -
R	0.650	0.670	- -	16.51	17.02	- -
T	0.210	0.225	- -	5.33	5.72	- -
U	0.310	0.330	- -	7.87	8.38	- -
V	- -	0.040	- -	- -	1.02	- -
AB	0.590	0.740	- -	14.99	18.80	- -
AC	0.760	0.885	- -	19.30	22.48	- -
AD	0.800	0.975	- -	20.32	24.77	- -

NOTES

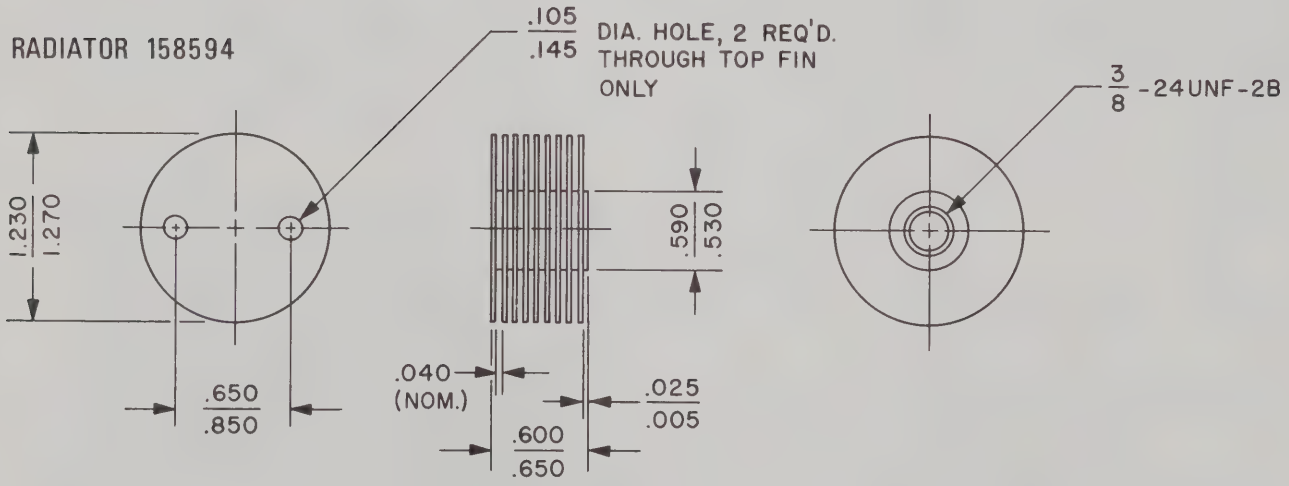
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. ANODE FLANGE IS ELECTRICAL CONTACT. STUD IS FOR HEAT TRANSFER.

EIMAC RADIATORS

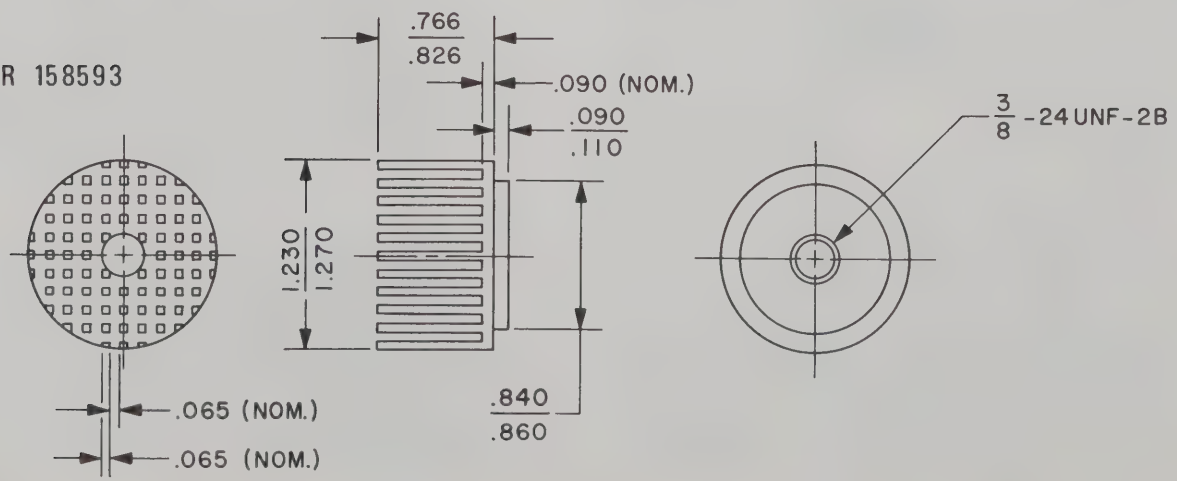
RADIATOR 014653



RADIATOR 158594



RADIATOR 158593



COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

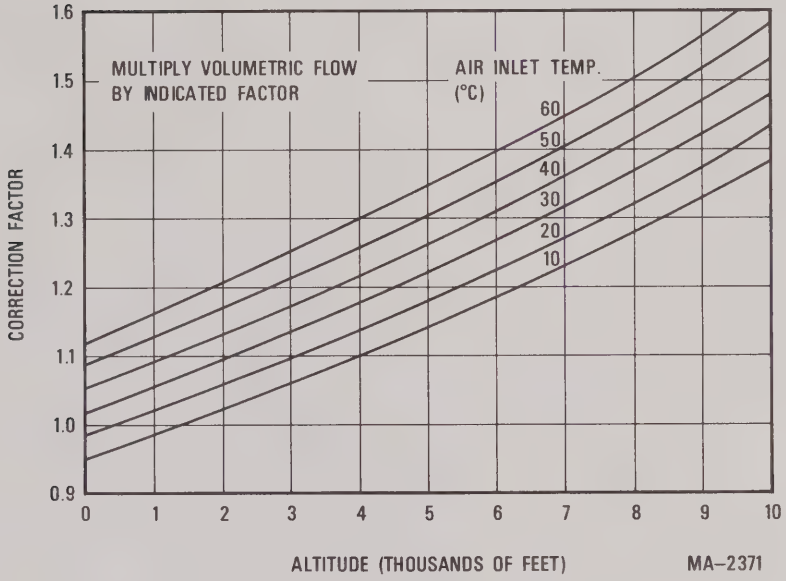
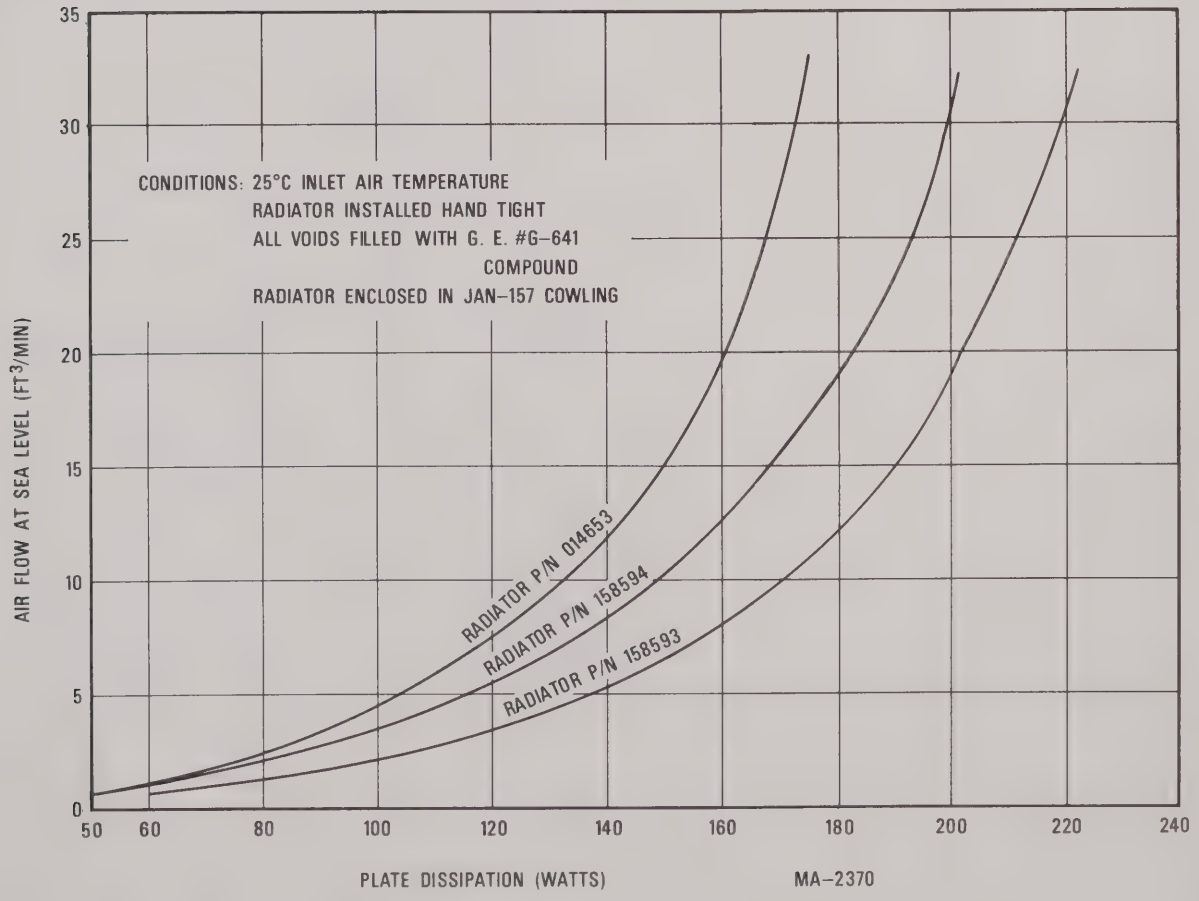
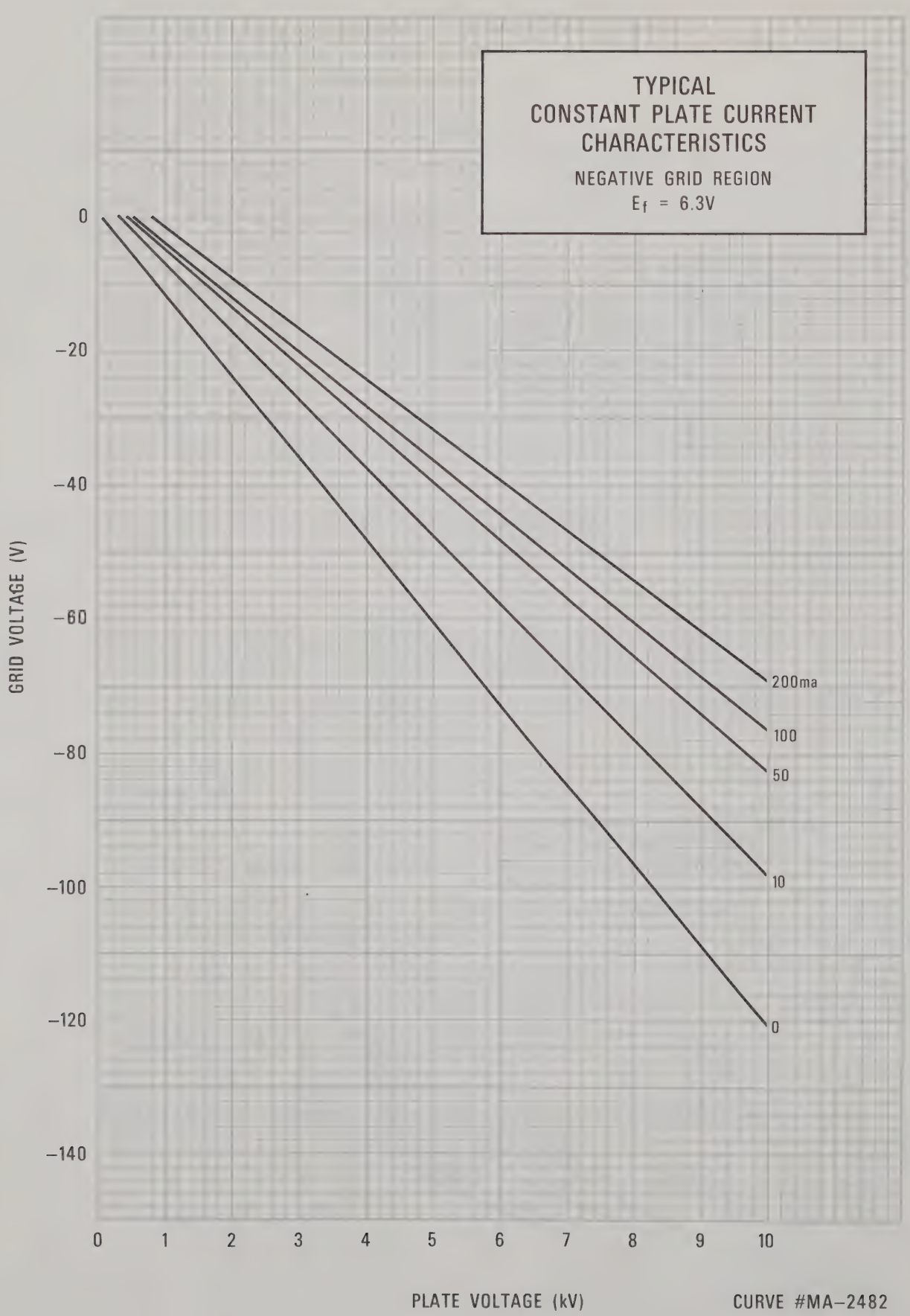
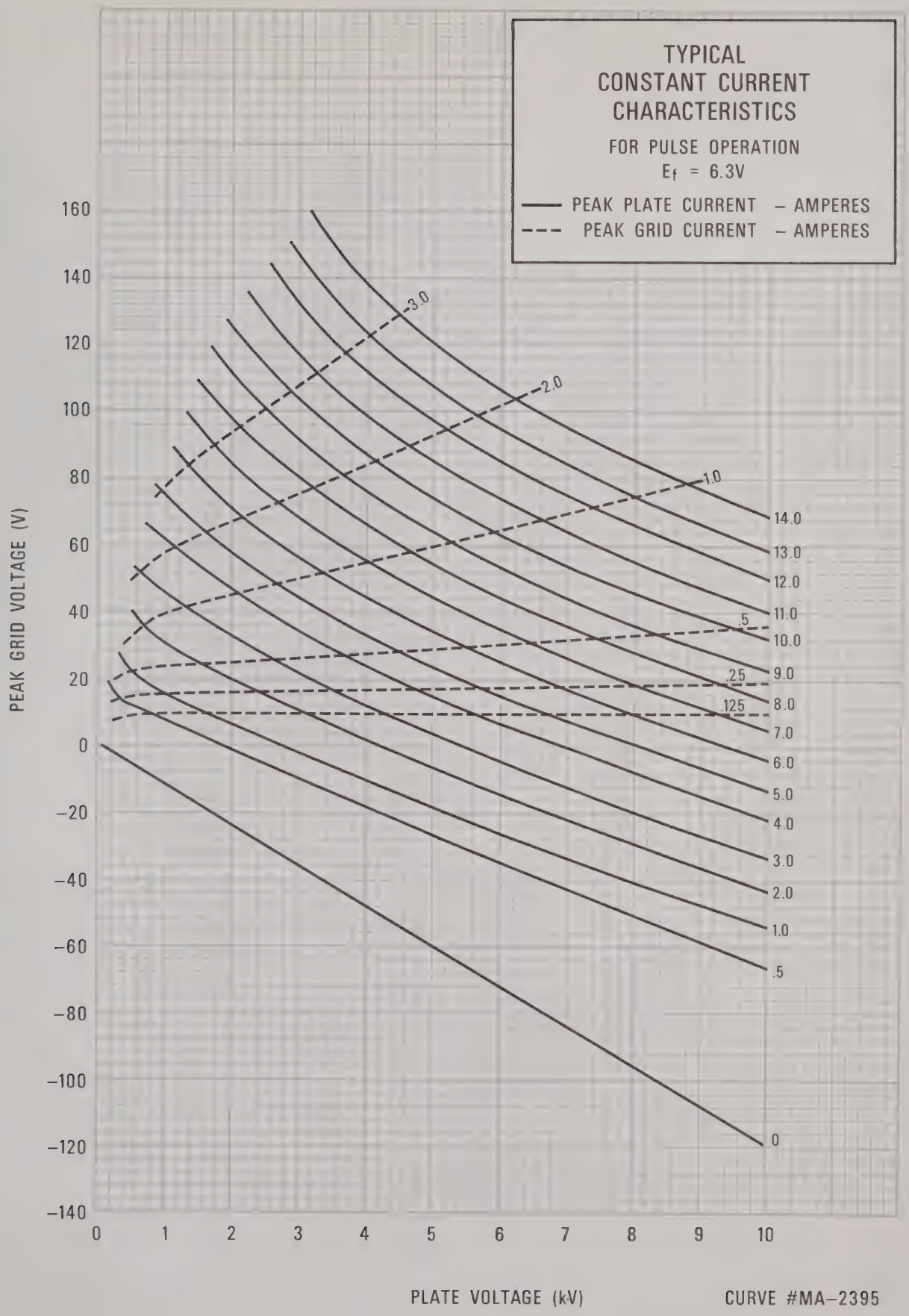
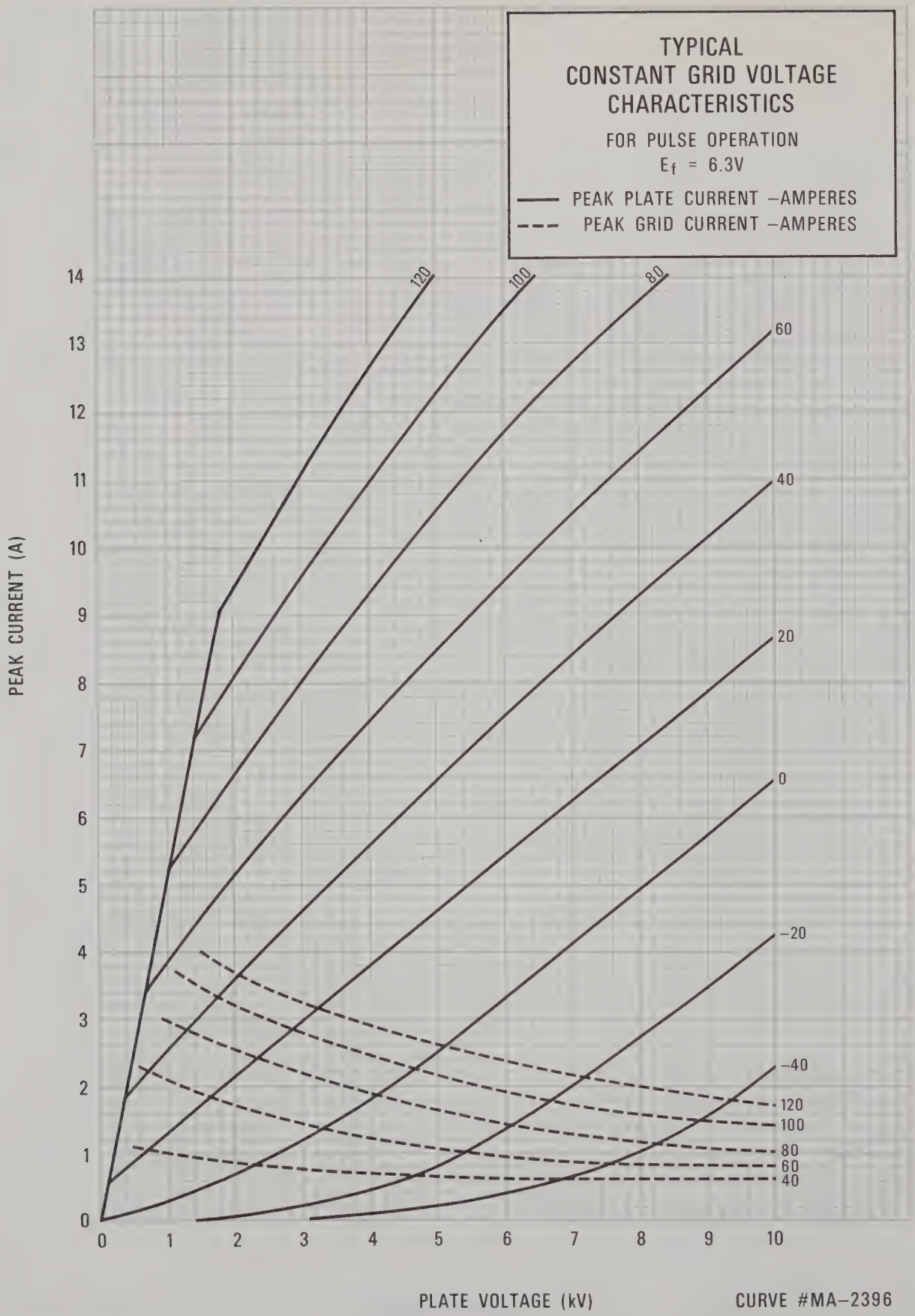


PLATE DISSIPATION VARIATION WITH COOLING AIR FLOW




TYPICAL
CONSTANT PLATE CURRENT
CHARACTERISTICS
NEGATIVE GRID REGION
E_f = 6.3V
0
−20
−40
−60
−80
−100
−120
−140
GRID VOLTAGE (V)
200ma
100
50
10
0
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE (kV)
CURVE #MA−2482


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PEAK PLATE CURRENT – AMPERES
PEAK GRID CURRENT – AMPERES
PEAK GRID VOLTAGE (V)
160
140
120
100
80
60
40
20
0
−20
−40
−60
−80
−100
−120
−140
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE (kV)
3.0
2.0
1.0
.5
.25
.125
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.5
0
CURVE #MA–2395



CURVE #MA–2396

TECHNICAL DATA

8163
3-400Z

HIGH-MU
POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten (see FILAMENT OPERATION)	
Voltage	5.0 V
Current	14.1 A
Amplification Factor (Average)	200
Interelectrode Capacitances (Average)[2], Grounded-Grid Connection:	
Cin	7.1 pF
Cout	4.1 pF
Cpk	0.1 pF
Frequency for Maximum Ratings	110 MHz

1. Characteristics and operating values are ased upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian EIMAC Division should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-All Dimensions:	
Height	5.500 In; 139.7 mm
Diameter	3.562 In; 90.47 mm
Net Weight (approximate)	7 Oz; 198 gm

(Effective 6-1-77) © 1961, 1967, 1968, 1974, 1977 by Varian Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GROUNDED-GRID, Class B

MAXIMUM RATINGS:

DC PLATE VOTAGE	4000 VOLTS
DC PLATE CURRENT	0.40 AMPERE
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

TYPICAL OPERATION (Single-Tone Conditions)

Plate Voltage	3000 Vdc
Zero Sig. Plate Current[1]	100 mAdc
Max. Sig. Plate Current	333 mAdc
Max. Sig. Grid Current[1]	120 mAdc
Driving Impedance	122 Ω
Resonant Load Impedance	4750 Ω
Max. Sig. Driving Power[1]	32 W
Peak Envelope Plate Output Power	655 W

TYPICAL OPERATION (Minimum Distortion Products)

Plate Voltage	2000 Vdc
Zero Sig. Plate Current[1]	62 mAdc
Single Tone Plate Current	400 mAdc
Single Tone Grid Current[1]	148 mAdc
Two Tone Plate Current	265 mAdc
Two Tone Grid Current[1]	87 mAdc
Driving Impedance	112 Ω
Resonant Load Impedance	2750 Ω
Max. Sig. Driving Power[1]	45 W
Peak Envelope Useful Output Power[1]	445 W
Intermodulation Distortion Products[2]	-40 dB

TYPICAL OPERATION (Minimum Distortion Products at 1 kW PEP Input)

Plate Voltage	2500 Vdc
Zero Sig. Plate Current[1]	73 mAdc
Single Tone Plate Current	400 mAdc
Single Tone Grid Current[1]	142 mAdc
Two Tone Plate Current	274 mAdc
Two Tone Grid Current[1]	82 mAdc
Driving Impedance	114 Ω
Resonant Load Impedance	3450 Ω
Peak Envelope Useful Output Power[1]	560 W
Max. Sig. Driving Power[1]	44 W
Intermodulation Distortion Products[2]	-35 dB

TYPICAL OPERATION (Minimum Distortion Products with Eb=1500 Vdc)

Plate Voltage	1500 Vdc
Zero Sig. Plate Current[1]	46 mAdc
Single Tone Plate Current	400 mAdc
Single Tone Grid Current[1]	163 mAdc
Two Tone Grid Current[1]	92 mAdc
Two Tone Plate Current	265 mAdc
Driving Impedance	109 Ω
Resonant Load Impedance	1620 Ω
Peak Envelope Useful Output Power[1]	300 W
Max. Sig. Driving Power[1]	46 W
Intermodulation Distortion Products[2]	-37 dB

1. Approximate value.

2. Approximate value; referenced against one tone of a two equal-tone signal.

AUDIO FREQUENCY AMPLIFIER OR MODULATOR, Class B

MAXIMUM RATINGS (PER TUBE):

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	0.40 AMPERE
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

1. Approximate value.

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000 Vdc
Grid Voltage	0 Vdc
Zero Sig. Plate Current[1]	200 mAdc
Max. Sig. Plate Current	666 mAdc
Max. Sig. Grid Current[1]	240 mAdc
Driving Power[1]	26 W
Peak af Driving Voltage (per tube)[1]	88 v
Load Resistance, Plate/Plate	9500 Ω
Max. Sig. Plate Output Power[1]	1310 W

RADIO FREQUENCY AMPLIFIER OR OSCILLATOR Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	0.35 AMPERE
PLATE DISSIPATION	400 WATTS
GRID DISSIPATION	20 WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000 Vdc
Plate Current	333 mAdc
Grid Voltage	-75 Vdc
Grid Current[1]	130 mAdc
Peak rf Grid Voltage[1]	187 v
Grid Driving Power[1]	25 W
Plate Output Power[1]	730 W

RADIO FREQUENCY AMPLIFIER[1],
Plate Modulated, Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	0.275 AMPERE
PLATE DISSIPATION	270 WATTS
GRID DISSIPATION	20 WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000 Vdc
Plate Current	245 mAdc
Grid Voltage	-90 Vdc
Grid Current[2]	100 mAdc
Peak rf Grid Voltage[2]	185 v
Grid Driving Power[2]	18 W
Plate Output Power[2]	550 W

NOTE: In most cases "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Max.	
Filament Current, at 5.0 volts	13.5	14.7	A
Zero Bias Plate Current (Eb=3000 Vdc)	80	115	mAdc
Cut-Off Voltage (Eb=3000 Vdc, Ib=1.0 mAdc)	---	-25	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	6.0	9.0	pF
Cout	---	0.15	pF
Cgp	3.4	4.8	pF
Interelectrode Capacitance (Grounded Grid Connection)[1]			
Cin	6.0	9.0	pF
Cout	3.4	4.8	pF
Cpk	---	0.15	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING - The 3-400Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit, and the tube should be protected from severe vibration and shock.

The EIMAC SK-410 Air-System Socket is especially recommended for mounting, as the contacting clips are made with considerable flexibility in order to avoid applying undue lateral pressure on the tube pins, to avoid the possibility of damage to the base of the tube. The tube should always be inserted or removed from the socket with a straight-in or straight-out motion, and "rocking" the tube in or out of any socket should be avoided.

If a socket other than the EIMAC SK-410 is employed, the user should assure himself that strong lateral pressure is not applied to the tube base pins. Otherwise, even though the base of the tube is reinforced, damage to the base seals may result.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an air temperature of 55°C. At higher inlet air temperatures,

higher altitudes, or at frequencies above 30 MHz, the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

FILAMENT OPERATION - The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

For best tube life the inrush current to the filament should be limited to two times normal current during turn-on. This will minimize thermal stress on the thoriated-tungsten filament wire, which can cause internal tube geometry changes with repeated cycling.

INTERMODULATION DISTORTION - Typical Operating conditions with distrotion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

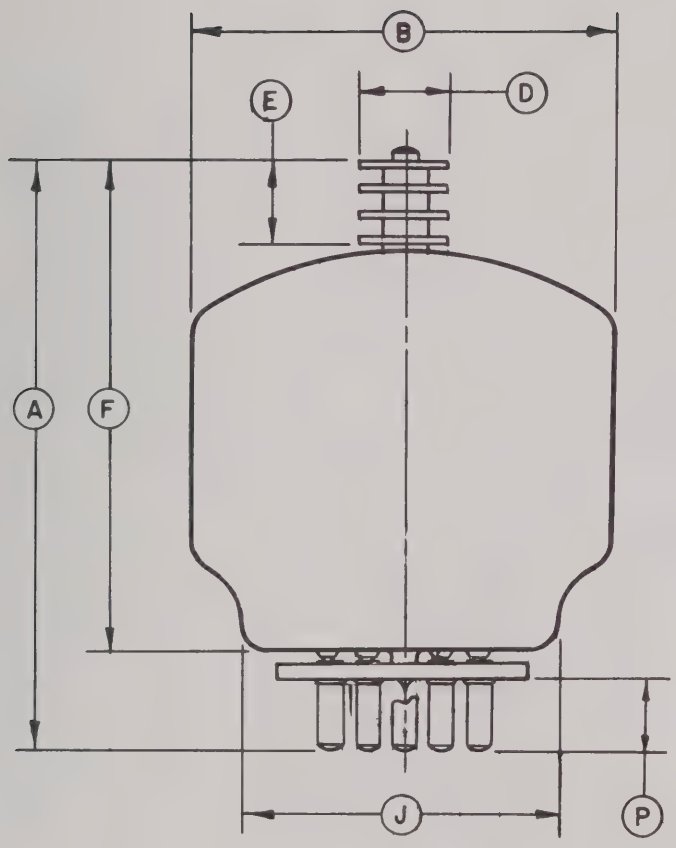
INPUT CIRCUIT - When the 3-400Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommend in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 8163/3-400Z are deadly, and the equipment must be disigned properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specifically constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, Varian EIMAC Division, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

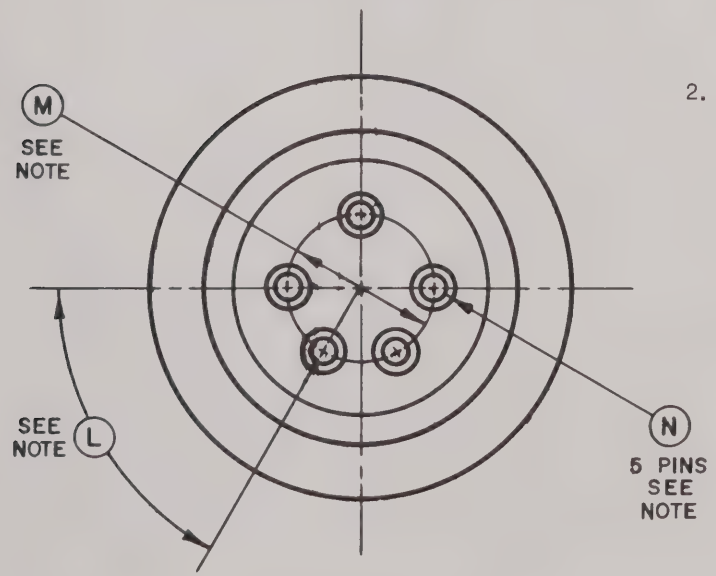


DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.000	5.500		127.00	139.70	
B		3.562			90.47	
D	.740	.760		18.80	19.30	
E	.635	.665		16.13	16.89	
F	3.937	4.437		100.00	112.70	
J		2.500			63.50	
K			1.075			27.30
L			60°			60°
M			1.250			31.75
N	.185	.191		4.69	4.85	
P	.700			17.78		

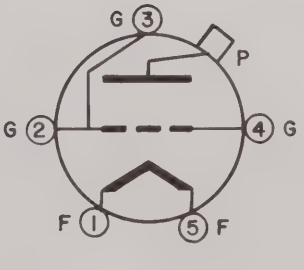
NOTES:

1. BASE PINS N ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4'' THICK WITH HOLE DIAMETERS OF 0.204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS L & M.

2. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.

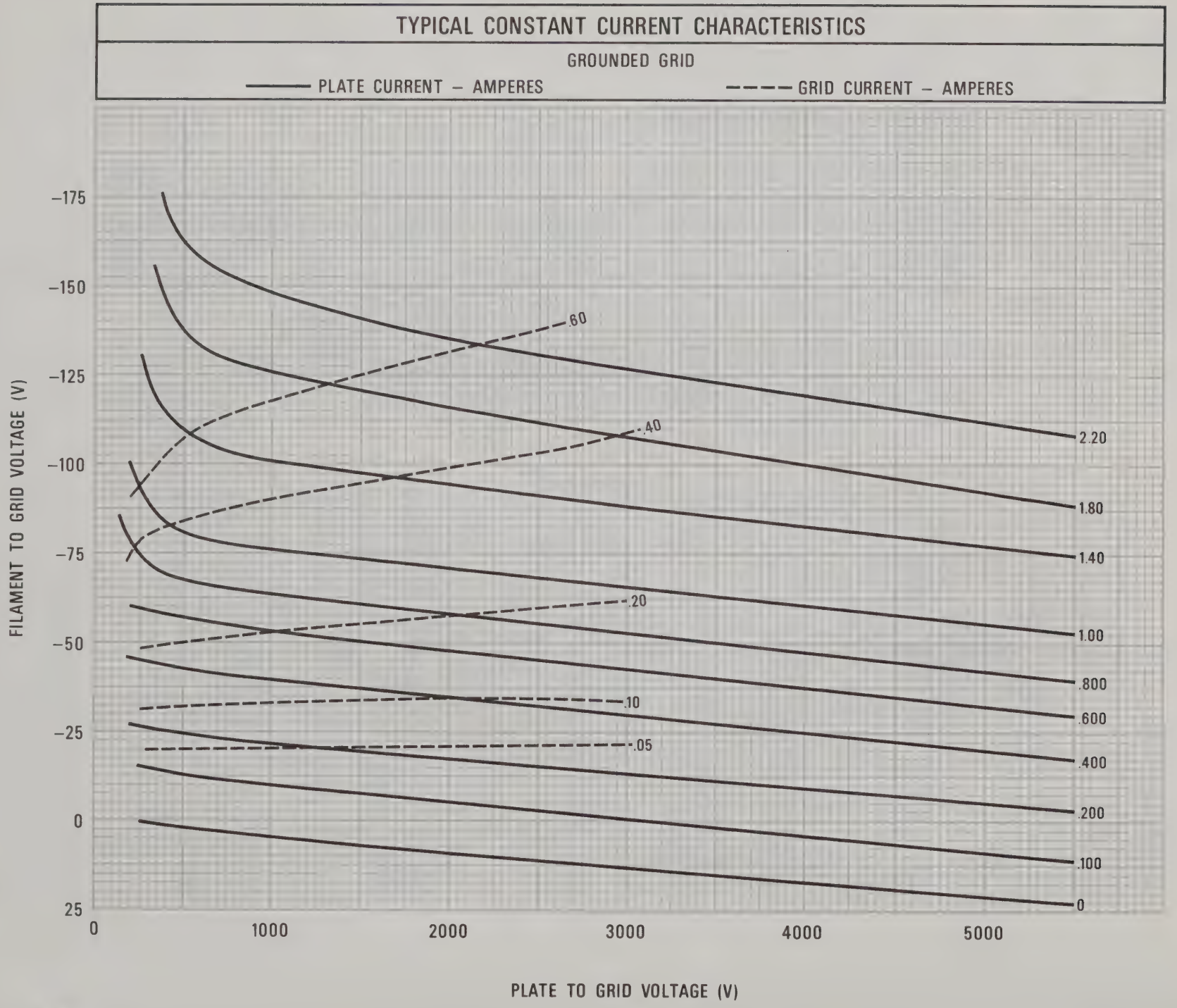


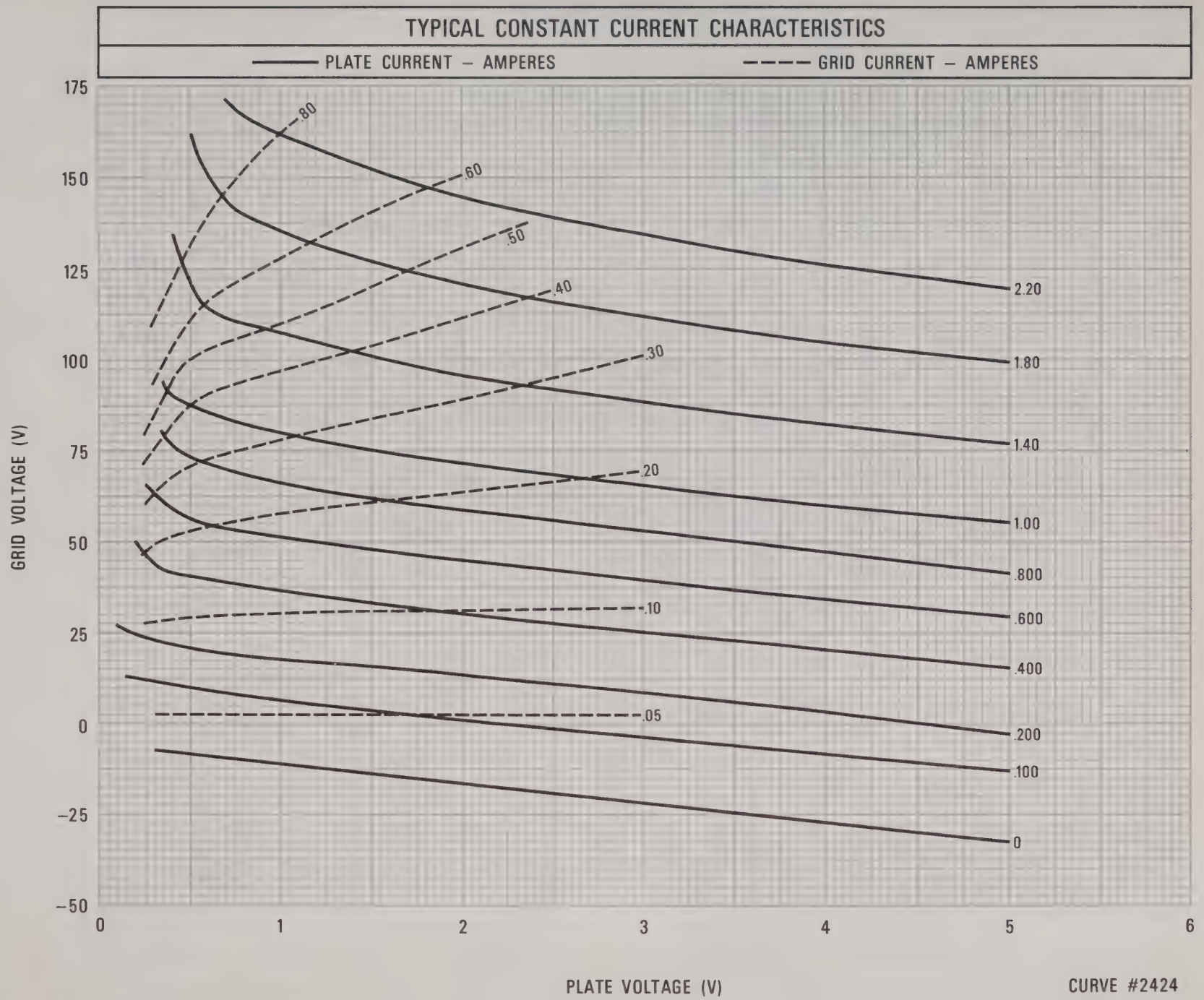
BOTTOM VIEW



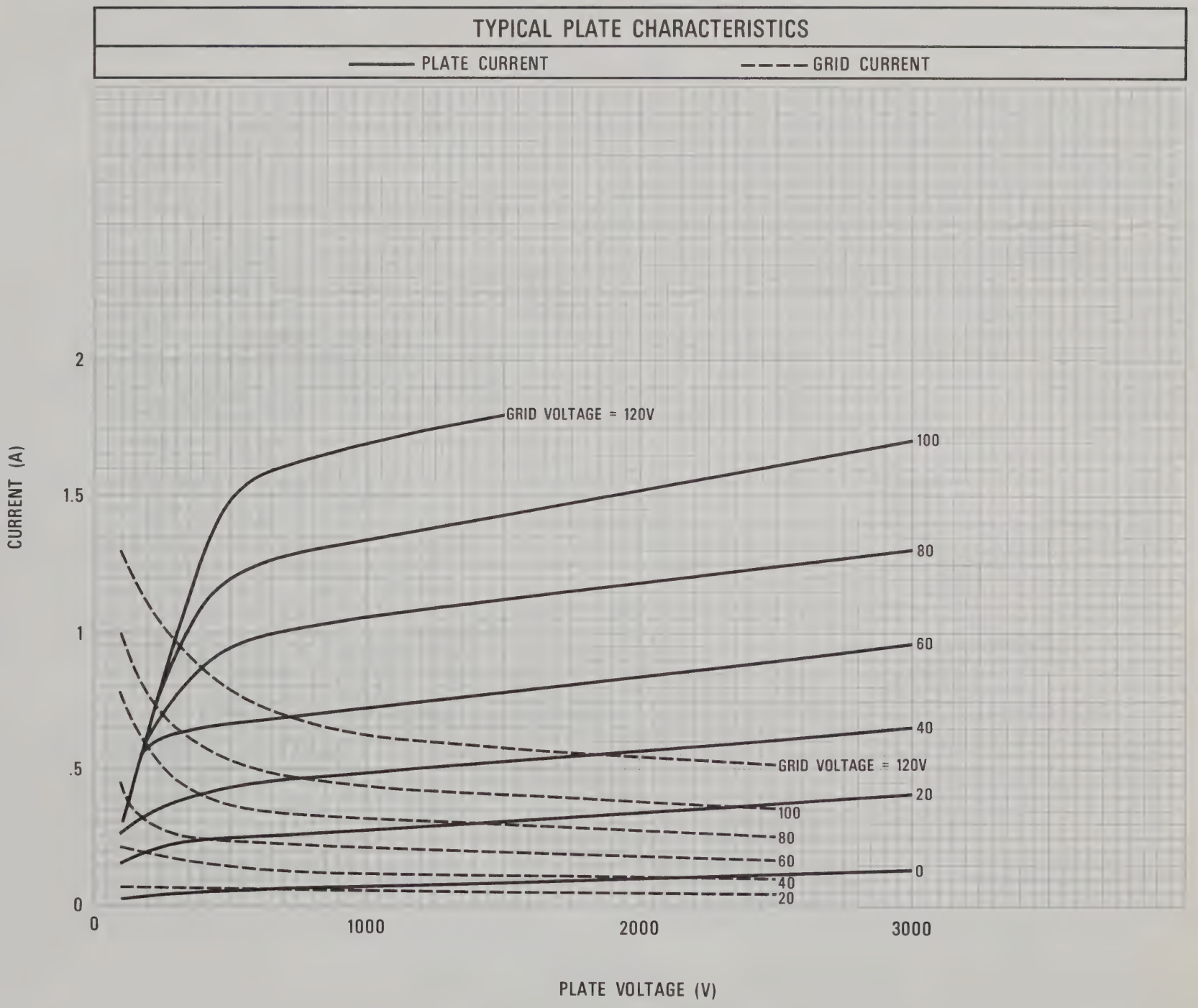
TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED GRID




TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
175
150
125
100
75
50
25
0
−25
−50
0
1
2
3
4
5
6
PLATE VOLTAGE (V)
.80
.60
.50
.40
.30
.20
.10
.05
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0
CURVE #2424

TYPICAL PLATE CHARACTERISTICS

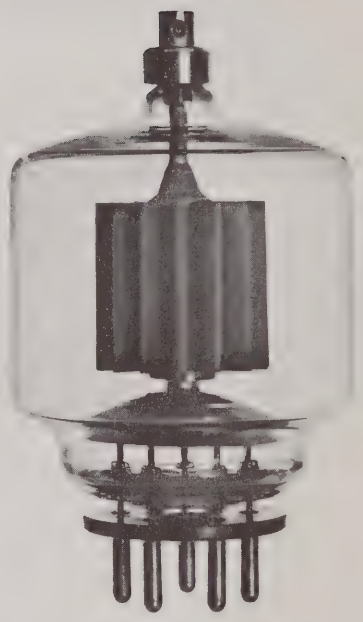


TECHNICAL DATA

3-500Z

HIGH-MU
POWER TRIODE

The EIMAC 3-500Z is a compact power triode intended to be used as a zero-bias Class AB2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3-500Z in a cathode-driven circuit.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

FILAMENT: Thoriated Tungsten (see FILAMENT OPERATION)	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.2 A
Amplification Factor (Average)	130
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	8.3 pF
Output	0.07 pF
Feedback	4.7 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Input	8.3 pF
Output	4.7 pF
Feedback	0.07 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division should be consulted before using this information for final equipment design.
2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.10 in; 154.94 mm
Diameter	3.44 in; 87.33 mm
Net Weight	7.0 oz; 198.5 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	5 Pin Special

(Revised 6-1-77) © 1968, 1970, 1973, 1977 by Varian Printed in U.S.A.

Recommended Socket ..... EIMAC SK-410
Recommended Chimney ..... EIMAC SK-406
Recommended Hear-Dissipating Connector;
Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

1. Zener diode positibe bias used at plate potentials of3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of curcuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two tone signal.

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB_2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[3,4]	400	400	400	400	400	mAdc
Two-Tone Plate Current	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	Ω
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	---	---	---	-46	-45	db

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN, CATHODE DRIVEN

Class AB_2 and C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	0	-75	0	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	260	187	215	215	V
Measured Driving Power	30	22	87	98	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	250	305	W
Useful Output Power	720	850	750	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	330	WATTS
GRID DISSIPATION[2]	20	WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	3000	Vdc
Grid Voltage	-100	Vdc
Plate Current	275	mAdc
Grid Current[1]	120	mAdc
Peak rf Grid Voltage[1]	200	V
Calculated Driving Power	25	W
Plate Input Power	825	W
Plate Dissipation	185	W
Plate Output Power	640	W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_2, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE[1]	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[2]	300	mAdc
Max. Signal Plate Current	770	mAdc
Max. Signal Grid Current[2]	244	mAdc
Peak rf Grid Voltage[3]	100	V
Peak Driving Power[4]	25	W
Plate Input Power	2310	W
Max. Signal Plate Dissipation	890	W
Plate Output Power	1420	W
Load Resistance (plate to plate)	8600	Ω

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurment. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	13.5	14.7	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	6.5	10.0	pF
Output	---	0.18	pF
Feedback	4.2	5.2	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	6.5	10.0	pF
Output	4.2	5.2	pF
Feedback	---	0.18	pF
Zero Signal Plate Current: (Ec = 0 Vdc, Eb = 2500 Vdc)	90	180	mAdc

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 3-500Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

SOCKET - The EIMAC SK-410 air system socket and SK-406 chimney are recommended for use with the 3-500Z. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the EIMAC SK-410 is employed, the user should assure himself that strong lateral pressure is not applied to the tube base pins. Otherwise, even though the base of the tube is reinforced, damage to the base seals may result.

CAUTION-GLASS IMPLOSION - The EIMAC 3-500Z is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will

result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. Air-flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches-H_2O)
300	6.6	0.23
400	10.3	.052
500	13.0	.082

The anode of the 3-500Z operates at a visibly red color at its maximum rated dissipation of 500 watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500Z tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3-inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon. Suitable products are manufactured by the Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, New Jersey 07080.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate voltages over 3000 since plate dissipation may be exceeded. A zener diode placing positive bias on the cathode or other constant voltage source may be used to reduce zero signal plate current at plate potentials over 2500 volts.

CLASS-C OPERATION - Although specifically designed for linear amplifier service, the 3-500Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-500Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-resistor bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 3-500Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

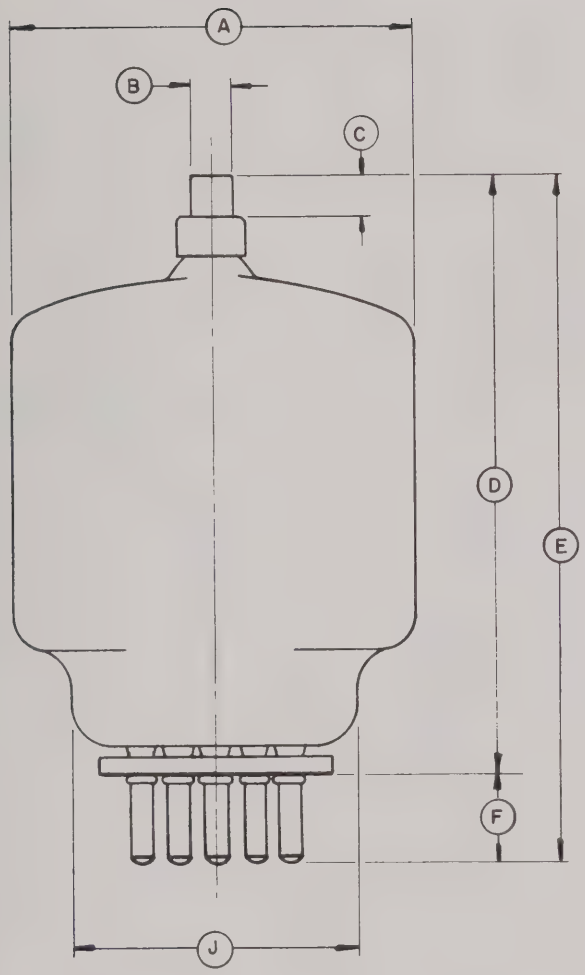
For best tube life the inrush current to the filament should be limited to two times normal current during turn-on. This will minimize thermal stress on the thoriated-tungsten filament wire, which can cause internal tube geometry changes with repeated cycling.

CAUTION-HIGH VOLTAGE - Operating voltage for the 3-500Z can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equiment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERMODULATION DISTORTION - Typical operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted.

INPUT CIRCUIT - When the 3-500Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of five or more.

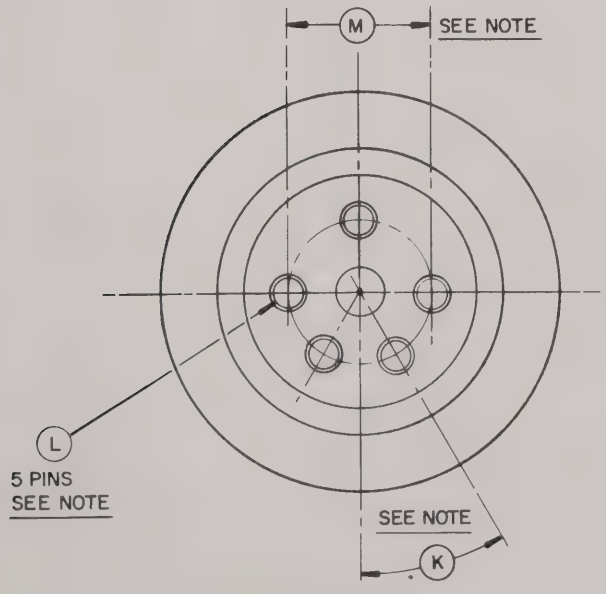
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070 for information and recommendation.

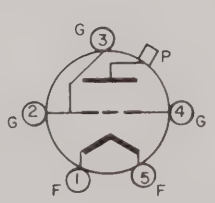


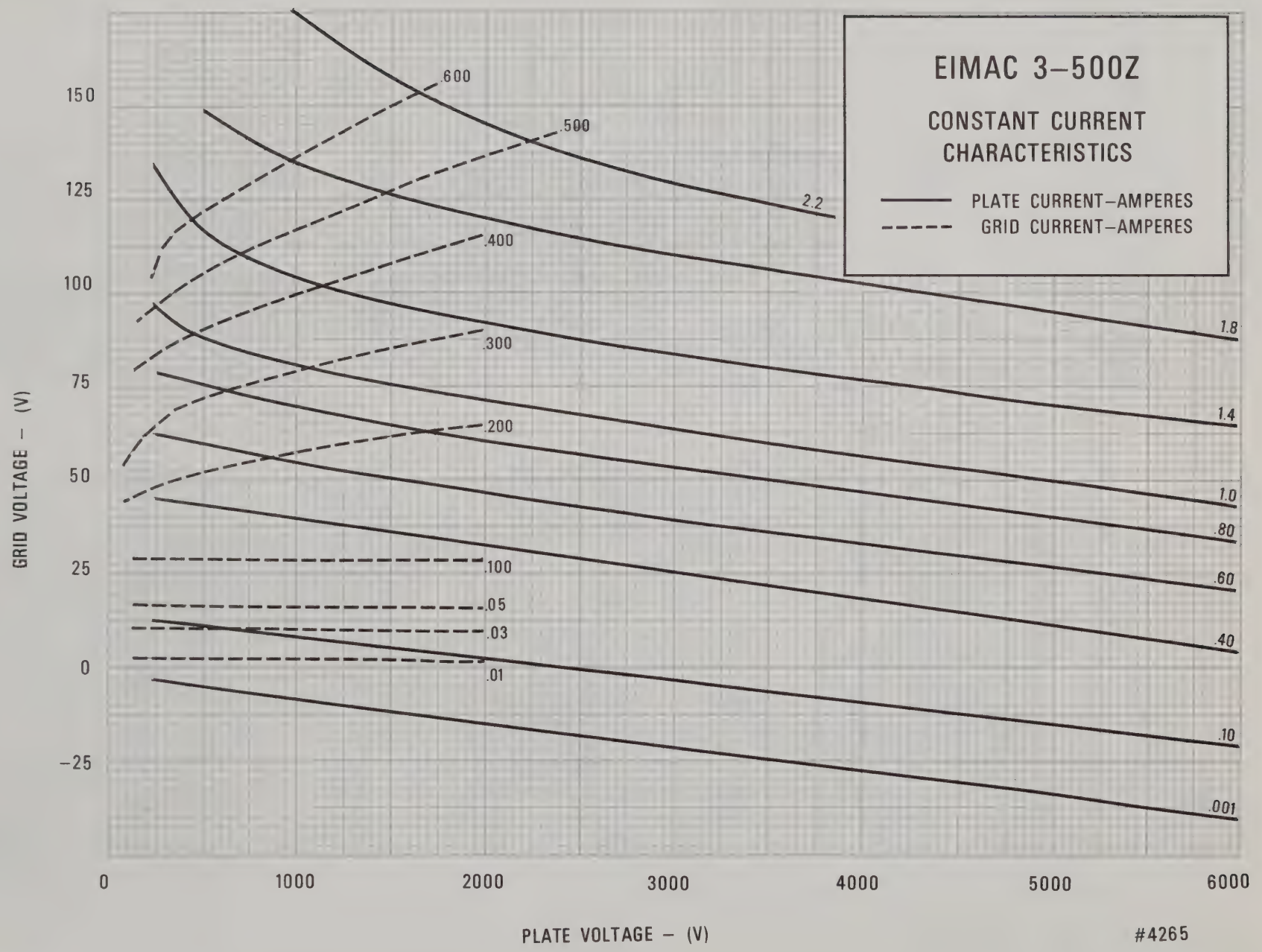
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		3.438			87.33	
B	.350	.365		8.89	9.27	
C	.328	.359		8.33	9.12	
D		5.200			132.1	
E	5.500	6.100		139.7	154.94	
F	.700			17.78		
G						
H						
I						
J		2.500			63.5	
K			30°			
L	.185	.191		4.7	4.85	
M			1.250			31.75

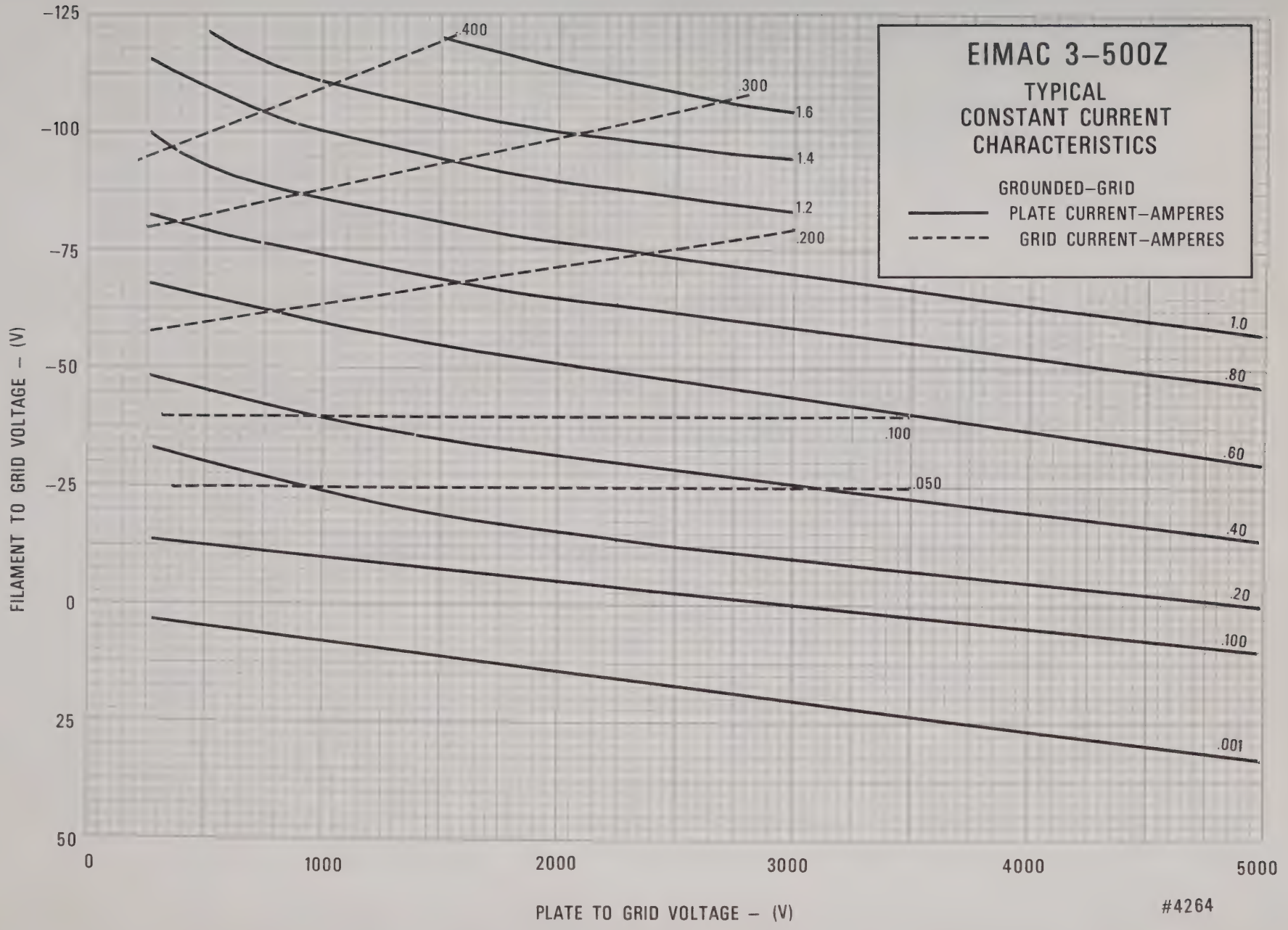
NOTES:

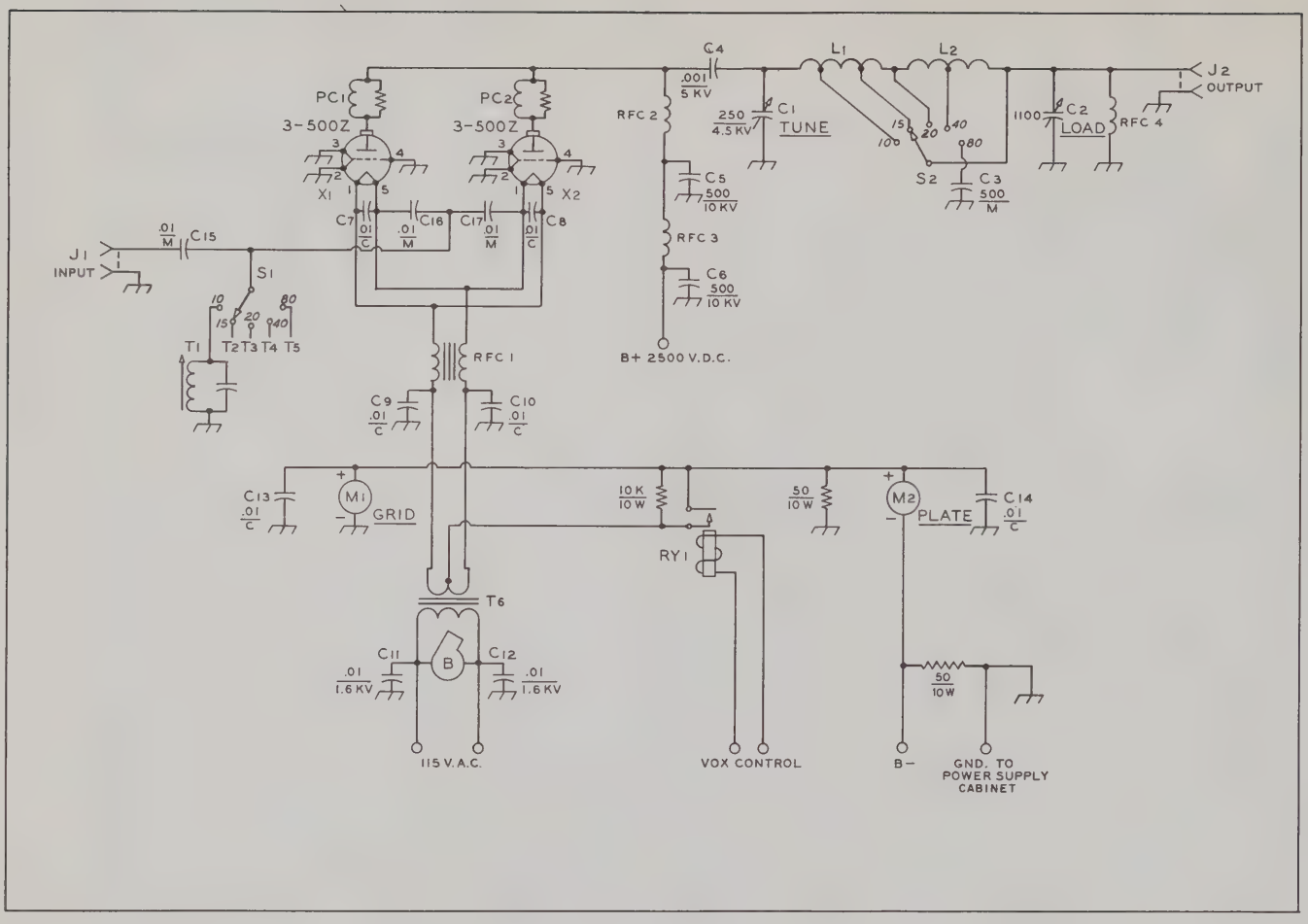
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. METRIC EQUIVALENTS TO THE NEAREST .01mm, ARE GIVEN FOR GENERAL INFO ONLY & ARE BASED ON 1 INCH=25.4mm.
3. BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THK. WITH HOLE DIAS. OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMS. (K) & (M)






EIMAC 3–500Z
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
.600
.500
.400
.300
.200
.100
.05
.03
.01
2.2
1.8
1.4
1.0
.80
.60
.40
.10
.001
150
125
100
75
50
25
0
–25
GRID VOLTAGE – (V)
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE – (V)
#4265


EIMAC 3–500Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
FILAMENT TO GRID VOLTAGE – (V)
PLATE TO GRID VOLTAGE – (V)
#4264
–125
–100
–75
–50
–25
0
25
50
0
1000
2000
3000
4000
5000
.400
.300
.200
.100
.050
1.6
1.4
1.2
1.0
.80
.60
.40
.20
.100
.001



TYPICAL CATHODE DRIVEN (GROUNDED GRID) AMPLIFIER CIRCUIT FOR TWO 3-500Z TUBES

C-1--250 pF, 4.5 kV (Johnson 154-16).

C-2--1100 pF, 3 section. Jackson Bros. LE-3-4595-380. (M. Swedgal, 258 Broadway, N.Y. 10007).

C-3-500 pF, 2.5 kV mica. Sangamo H-5347.

C-4--.001 μF, 5kV. Centralab 858S-1000.

C-5, C-6--500 pF, 10 kV, TV "door knob" capacitor.

C-7 thru C-10--.01μF, 600V ceramic capacitor (Centralab DD-103).

C-11, C-12--.01 μF, 1.6 kV ceramic capacitor (Centralab DD16-103).

C-13, C-14--.01 pF, 600V ceramic capacitor (Centralab DD-103).

C-15 thru C-17--.01 μF, 1 kV mica capacitor (Sangamo H-2210).

M-1--500 mAdc.

M-2--1000 mAdc.

RFC-1--50 μH. 14 bifilar turns #10 AWG enamelled wire wound on ferrite core, 5inches long, ½ inch diameter. (Permag Central Corp., 1213 Estes Avenue, Elk Grove Village, IL 60007; Catalog #S-206-Q1). Notch core with file and break to length.

RFC-2-100 μH, 1 Adc. 112 turns #26 AWG, spacewound wire diameter on 1" diam., 6" long ceramic from (Centralab X-3022H insulator). Series resonant with terminals shorted to 24.5 MHz.

RFC-3--1.7 μH, 1 Adc. 20 turns #26 AWG wound on 100K, 2W resistor (J.W. Miller RFC-144).

RY-1--VOX operated SPST relay. Energized when transmit.

PC-1, PC-2--Three 100 ohm, 2W carbon resistors in parallel. Three turns #14 AWG, ½" diam., ¾" long in parallel with resistors. (Equivalent: Ohmite P-300 reduced to 3 turns).

J-1, J-2--Coaxial receptacle. UG-58A/U, for type N connector.

T-6--5 V at 30 amp. Chicago-Stancor P-4648.

X-1, X-2--EIMAC SK-410 socket and EIMAC SK-406 chimney.

B-Blower--13 cubic feet at 0.2 inch back pressure. Use #3 impeller at 3100 rpm. (Ripley 8472, Dayton 1C-180 or Redmond AK-2H-01AX).

CATHODE CIRCUIT COMPONENTS:

T-1 (10 meters)--0.15 H. 4 turns #14 AWG on ½-inch form, ½-long. Parallel capacitance: 200 pF, 1 kV silver mica capacitor. Resonant at 28.7 MHz.

T-2 (15 meters)--0.15 μH, same as T-1. Resonant at 21.3 MHz with 470 pF, 1 kV silver mica capacitor.

T-3 (20 meters)--0.31 μH. 6 turns #14 AWG on ½-inch form, ½-inch long, slug tuned (National XR-50). Resonant at 14.2 MHz with 470 pF, 1 kV silver mica capacitor.

T-4 (40 meters)--0.31 μH, same as T-3. Resonant at 7.2 MHz with 940 pF. (Two 470 pF 1 kV silver mica capacitors in parallel).

T-5 (80 meters)--1.3 μH. 13 turns #18 AWG on ½-inch diameter form, ½-inch long, slug turned (National XR-50). Resonant at 3.8 MHz with 940 pF, same as T-4.

PLATE CIRCUIT COMPONENTS (for plate potential of 2500 Vdc), R_L=1725 Ω:

The 10, 15 and 20 meter inductor (L_1) may be 10½ turns #8 AWG copper wire (or 3/16" tubing) 2" diam., 3" long. Ten meter tap is 5¼ turns from plate end; 15 meter tap is 7¼ turns from plate end. The 40-80 meter coil (L_2) may be 16 turns #10 AWG, 2½" diam., 4" long. 40 meter tap is 8 turns from junction with coil L-1.

S-2--Single pole ceramic switch, high voltage 30° index. Radio Switch Corp. Model 86-A.

NOTE: For additional data on plate circuit design, write for Amateur Service Bulletin #30, "Pi and Pi-L Networks for Linear Amplifier Service".

NOTE: B- of power supply is floating and grounded only through plate meter M_2 and the 50 ohm safety resistor. Cabinet of power supply should be grounded to amplifier cabinet as safety measure.

TECHNICAL DATA

8877
3CX1500A7

HIGH-MU
POWER TRIODE

The EIMAC 8877/3CX1500A7 is a rugged ceramic/metal power triode designed for use as a cathode driven Class AB_2 or Class B amplifier, in audio or rf applications including the UHF band, or as a cathode driven plate modulated Class C rf amplifier. As a linear amplifier, high power gain may be obtained without sacrifice of low intermodulation characteristics.



Low grid interception and high amplification factor combine to make the 8877/3CX1500A7 drive power requirements exceptionally low for a tube of this power capacity.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.0 ± 0.25	V
Current, at 5.0 volts	10.5	A
Transconductance (Average):		
I_b = 1.0 Adc	55,000	μmhos
Amplification Factor (Average)	200	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	38.5	pF
Cout	0.1	pF
Cgp	10	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	38.5	pF
Cout	10	pF
Cpk	0.1	pF
Ck-htr	9.7	pF
Frequency of Maximum Rating:		
CW	250	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Revised 7-1-75) © 1970, 1971, 1973, 1975 by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.02 in;102.16 mm
Diameter	3.38 in; 85.85 mm
Net Weight	25.0 oz; 708.8 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals, Anode Core	250°C
Cooling	Forced Air
Base	Special 7-pin
Recommended Air System Socket	
(Grounded Grid)	SK-2210
(Grounded Cathode)	SK-2200
Recommended Air Chimney	
(Teflon)	SK 2216

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.0 volts	9.5	11.5	A
Cathode Warmup Time	90	---	sec
Interelectrode Capacitance (grounded grid circuit)[1]			
Cin	36.0	41.0	pF
Cout	9.2	11.2	pF
Cpk	---	0.2	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN Class AB_2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2 Cathode Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2700	3500	Vdc
Cathode Voltage[1]	+8.2	+8.2	Vdc
Zero-Signal Plate Current[3]	92	182	mAdc
Single-Tone Plate Current	740	1000	mAdc
Two-Tone Plate Current	480	675	mAdc
Single-Tone Grid Current[3]	40	74	mAdc
Two-Tone Grid Current[3]	16	25	mAdc
Peak rf Cathode Voltage[3]	68	81	v
Peak Driving Power[3]	40	64	w
Single-Tone Useful Output Power[3]	1085	2075	W
Resonant Load Impedance	1820	2000	Ω
Intermodulation Distortion Products[2]			
3rd Order	-40	-38	dB
5th Order	-41	-41	dB

1. Positive cathode bias provided by zener diode.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (220 MHz)
Class AB_2 Cathode Driven

Plate Voltage	2500	Vdc
Cathode Voltage[1]	+8.2	Vdc
Plate Current	1000	mAdc
Grid Current[2]	10	mAdc
Useful Output Power[2]	1520	W
Driving Power[2]	57	W
Power Gain[2]	14	dB

1. Positive cathode bias provided by zener diode.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class B Telegraphy or FM
(Continuous Operating Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (88-108 MHz) Measured Values
Class B, Cathode Driven

Plate Voltage	2000	2500	3000	4000	Vdc
Cathode Voltage[1,2]	+9	+12	+15	+20	Vdc
Plate Current	1.0	1.0	1.0	1.0	Adc
Grid Current[2]	60	58	42	25	mAdc
Driving Power[2]	64	54	65	78	W
Useful Power Output[3]	1330	1670	1960	2600	W
Efficiency[4]	66.5	66.7	65.5	65.2	%
Power Gain[4]	13.2	14.2	14.8	15.3	dB

1. For measured case, idling anode current was set for 10 mAdc.
2. Approximate.
3. Approximate, delivered to the load.
4. For the measured case; may vary from tube to tube.

RADIO FREQUENCY POWER AMPLIFIER

Class C - Cathode Driven, Plate Modulated

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3200	VOLTS
DC PLATE CURRENT	0.8	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION Carrier Conditions, Frequencies to 30 MHz, Cathode Driven

Plate Voltage	2400	Vdc
Cathode Voltage[1]	+22	Vdc
Plate Current	600	mAdc
Grid Current[2]	45	mAdc
Plate Load Resistance	2000	Ω
Driving Power[3]	41	W
Plate Output Power	1000	W
Power Gain	14	dB

1. Bias may be obtained from a fixed supply of 15.8 volts in series with a 9.5 ohm resistor. The resistor & supply should be bypassed for audio frequencies.
2. Approximate.
3. Approximate, and driver must be modulated approximately 83%.

APPLICATION

MECHANICAL

MOUNTING - The 8877/3CX1500A7 may be mounted in any position.

SOCKET - The grid of the 8877/3CX1500A7 terminates in the cylindrical grid ring about the base of the tube. This may be contacted by multiple clips or flexible finger stock. Connections to the heater and cathode are made via the 7-pin base.

COOLING - The maximum temperature limit for external tube surfaces and the anode core is 250°C. Tube life is prolonged if these areas are maintained at lower temperatures. For full 1500 watt anode dissipation 38.0 cfm of air is required at a back pressure of 0.60 inches to hold tube temperature below 225°C with 50°C ambient temperature at sea level. At frequencies higher than 30 MHz, or at high altitudes, the air quantity must be increased.

Base-to-Anode Air Flow (sea level)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H 0
500	7.5	0.10
1000	22.5	0.20
1500	35.0	0.41
Base-to-Anode Air Flow (10,000 ft.)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H 0
500	11.0	0.15
1000	32.5	0.29
1500	51.0	0.60

Note: 1) Tube mounted in SK-2200 Socket with SK-2216 Chimney.
2) An allowance of 25 watts has been made for grid dissipation and 50 watts for filament power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8877/3CX1500A7 is 5.0 volts. Filament voltage, as measured at the socket optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 8877/3CX1500A7 is operated as a cathode driven rf amplifier, the use of a resonant circuit in the cathode is recommended. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of two or more.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate potentials over 3000 volts, since plate dissipation may be exceeded. Higher plate voltage may be used with the proper protective bias.

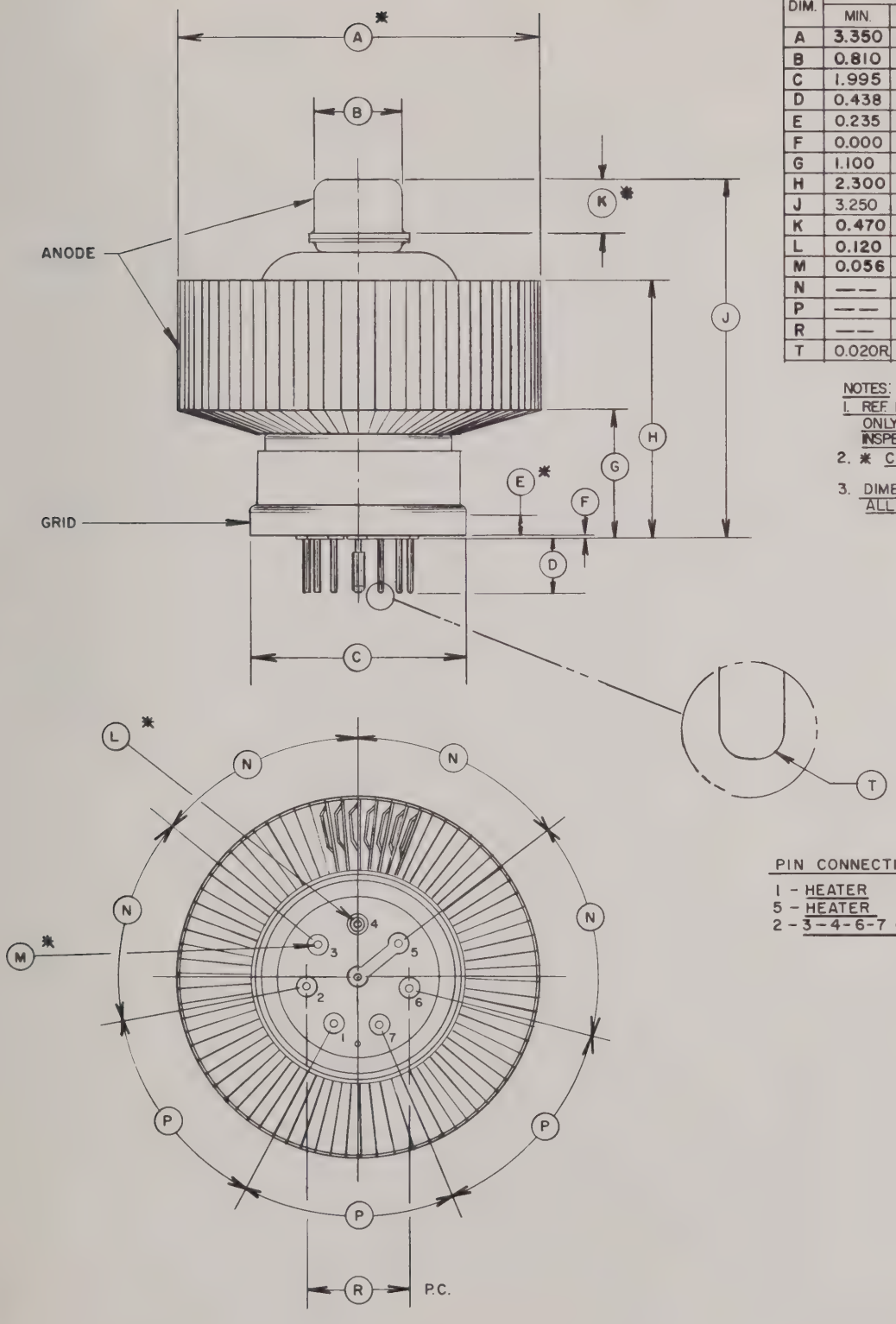
HIGH VOLTAGE - The 3CX1500A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

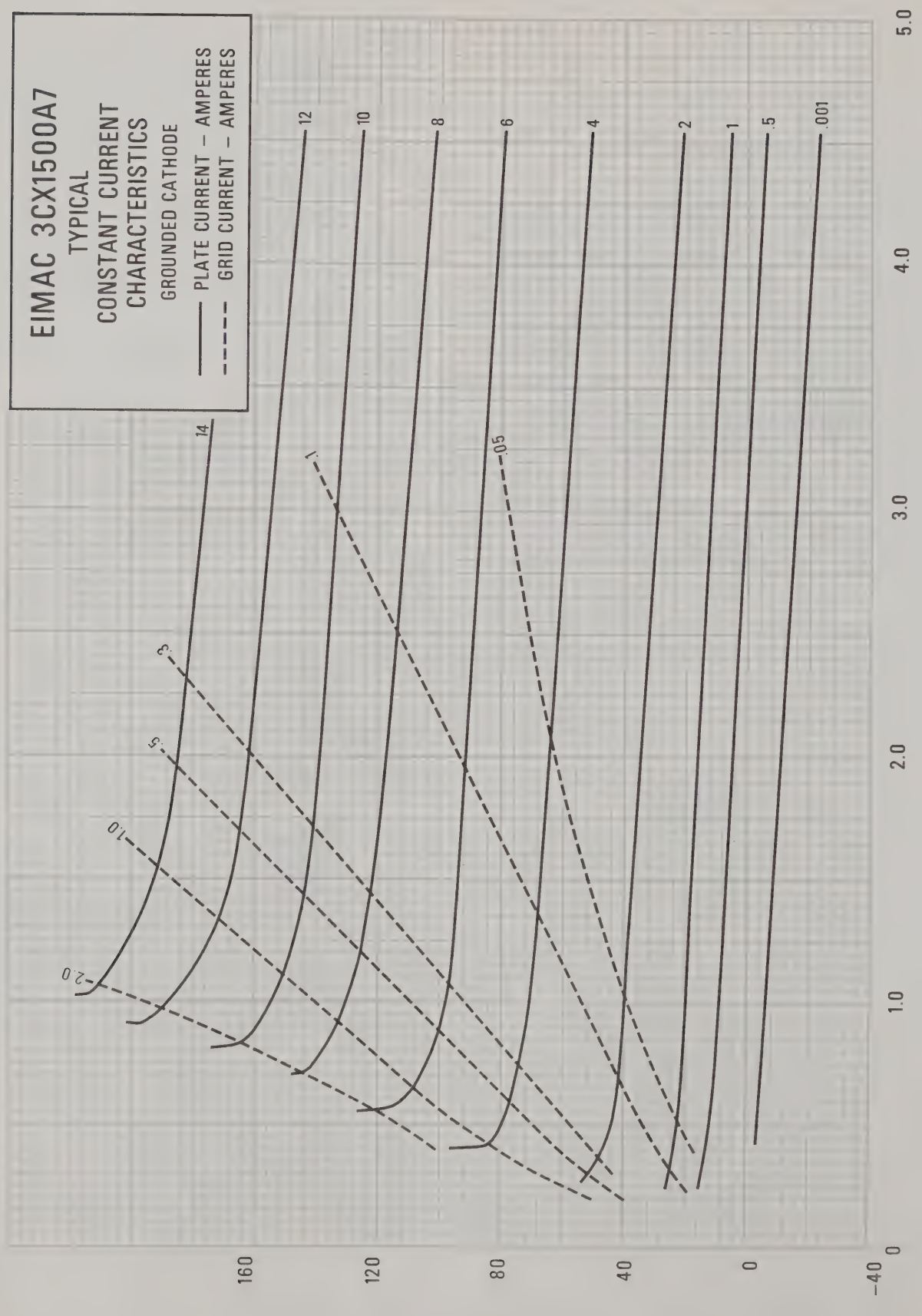


DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.350	3.380	— —	85.09	85.85	— —
B	0.810	0.820	— —	20.57	20.83	— —
C	1.995	2.015	— —	50.67	51.18	— —
D	0.438	0.562	— —	11.13	14.27	— —
E	0.235	— —	— —	5.97	— —	— —
F	0.000	0.040	— —	0.00	1.02	— —
G	1.100	1.225	— —	27.94	31.12	— —
H	2.300	2.425	— —	58.42	61.60	— —
J	3.250	3.420	— —	82.55	86.87	— —
K	0.470	0.530	— —	11.94	13.46	— —
L	0.120	0.127	— —	3.05	3.23	— —
M	0.056	0.062	— —	1.42	1.57	— —
N	— —	— —	51°	— —	— —	51°
P	— —	— —	52°	— —	— —	52°
R	— —	— —	1.000	— —	— —	25.40
T	0.020R	— —	— —	0.51R	— —	— —

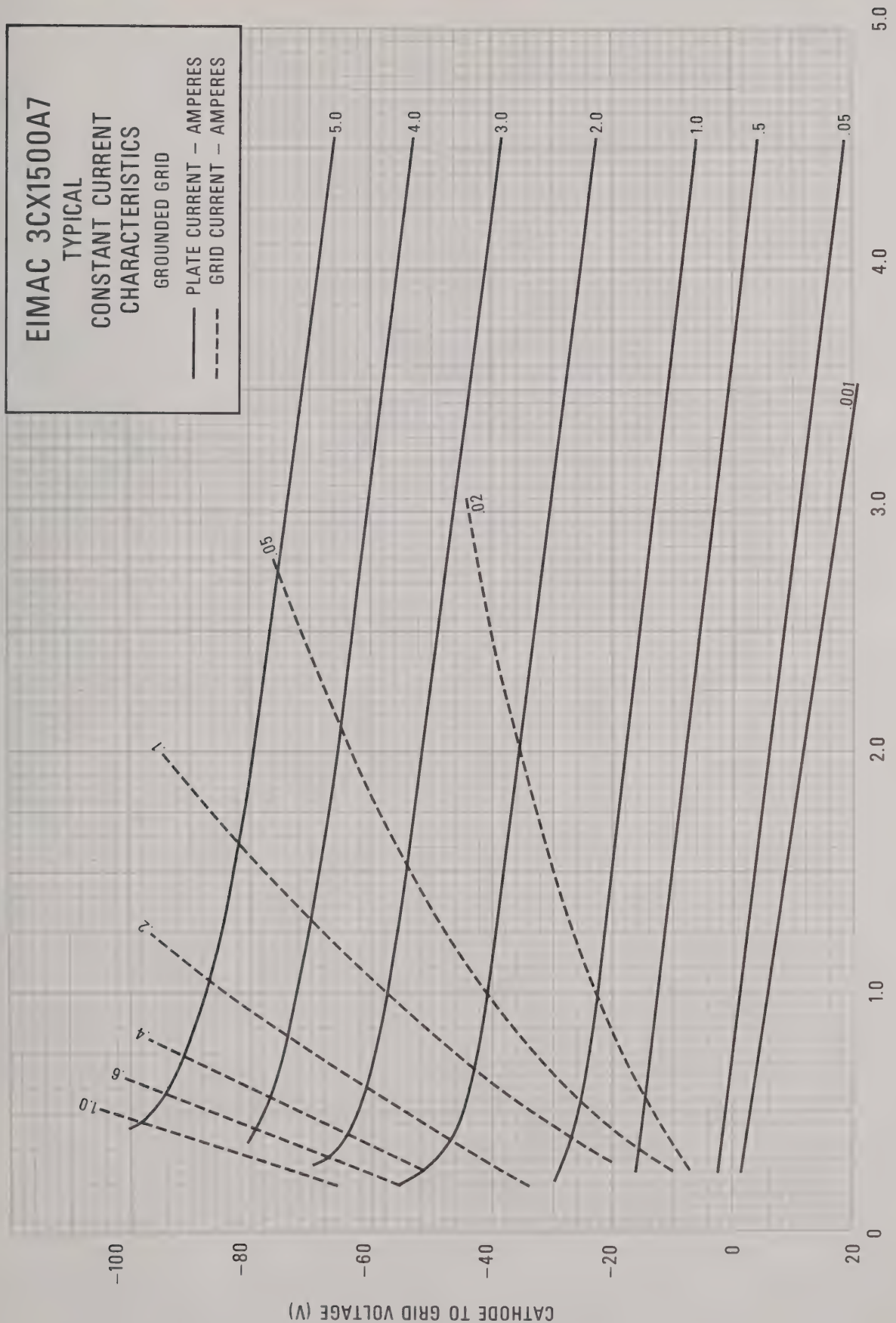
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. ✱ CONTACT SURFACE
3. DIMENSION T APPLIES TO ALL BUT CENTER PIN.

PIN CONNECTIONS

1 - HEATER
5 - HEATER
2 - 3-4-6-7 CATHODE


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
14
12
10
8
6
4
2
1
.5
.001
2.0
1.0
.5
.2
.1
.05
160
120
80
40
0
−40
0
1.0
2.0
3.0
4.0
5.0
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)

CURVE #4211


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
5.0
4.0
3.0
2.0
1.0
.5
.05
.001
.05
.02
1
2
4
6
10
-100
-80
-60
-40
-20
0
20
0
1.0
2.0
3.0
4.0
5.0
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (kV)

CURVE #4250

TECHNICAL DATA

8877
3CX1500A7

HIGH-MU
POWER TRIODE



The EIMAC 8877/3CX1500A7 is a rugged ceramic/metal power triode designed for use as a cathode driven Class AB_2 or Class B amplifier, in audio or rf applications including the VHF band, or as a cathode driven plate modulated Class C rf amplifier. As a linear amplifier, high power gain may be obtained without sacrifice of low intermodulation distortion characteristics.

Low grid interception and high amplification factor combine to make the 8877/3CX1500A7 drive power requirements exceptionally low for a tube of this power capacity.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	10.5 A
Transconductance (Average):	
I_b = 1.0 Adc	55,000 μ mhos
Amplification Factor (Average)	200
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	38.5 pF
Cout	0.1 pF
Cgp	10 pF
Direct Interelectrode Capacitance (grounded grid)[2]	
Cin	38.5 pF
Cout	10 pF
Cpk	0.1 pF
Ck-htr	9.7 pF
Frequency of Maximum Rating:	
CW	250 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Revised 5-15-77) © 1970, 1971, 1973, 1975, 1977 by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.02 in; 102.16 mm
Diameter	3.38 in; 85.85 mm
Net Weight	25.0 oz; 708.8 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals, Anode Core	250°C
Cooling	Forced Air
Base	Special 7-pin
Recommended Air System Socket	
(Grounded Grid)	SK-2210
(Grounded Cathode)	SK-2200
Recommended Air Chimney	
(Teflon)	SK-2216

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.0 volts	9.5	11.5	A
Cathode Warmup Time	180	---	sec
Interelectrode Capacitance (grounded grid circuit)[1]			
Cin	36.0	41.0	pF
Cout	9.2	11.2	pF
Cpk	---	0.2	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN Class AB_2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	1.0 AMPERE
PLATE DISSIPATION	1500 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2 Cathode Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2700	3500	Vdc
Cathode Voltage[1]	+8.2	+8.2	Vdc
Zero-Signal Plate Current[3]	92	182	mAdc
Single-Tone Plate Current	740	1000	mAdc
Two-Tone Plate Current	480	675	mAdc
Single-Tone Grid Current[3]	40	74	mAdc
Two-Tone Grid Current[3]	16	25	mAdc
Peak rf Cathode Voltage[3]	68	81	v
Peak Driving Power[3]	40	64	w
Single-Tone Useful Output Power[3]	1085	2075	W
Resonant Load Impedance	1820	2000	Ω
Intermodulation Distortion Products[2]			
3rd Order	-40	-38	dB
5th Order	-41	-41	dB

1. Positive cathode bias provided by zener diode.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (220 MHz)
Class AB2 Cathode Driven

Plate Voltage	2500 Vdc
Cathode Voltage[1]	+8.2 Vdc
Plate Current	1000 mAdc
Grid Current[2]	10 mAdc
Useful Output Power[2]	1520 W
Driving Power[2]	57 W
Power Gain[2]	14 dB

1. Positive cathode bias provided by zener diode.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class B Telegraphy or FM
(Continous Operating Conditions)

DC PLATE VOLTAGE ..... 4000 VOLTS
DC PLATE CURRENT ..... 1.0 AMPERE
PLATE DISSIPATION ..... 1500 WATTS
GRID DISSIPATION ..... 25 WATTS

1. For measured case, idling anode current was set for 10 mAdc.
2. Approximate.
3. Approximate, delivered to the load.
4. For the measured case; may vary from tube to tube.

TYPICAL OPERATION (88-108 MHz)
Measured Values Class B, Cathode Driven

Plate Voltage	2000	2500	3000	4000	Vdc
Cathode Voltage[1,2] ..	+9	+12	+15	+20	Vdc
Plate Current	1.0	1.0	1.0	1.0	Adc
Crid Current[2]	60	58	42	25	mAdc
Driving Power[2]	64	54	65	78	W
Useful Power Output[3]	1330	1670	1960	2600	W
Efficiency[4]	66.5	66.7	65.5	65.2	%
Power Gain[4]	13.2	14.2	14.8	15.3	dB

RADIO FREQUENCY POWER AMPLIFIER

Class C - Cathode Driven, Plate Modulated

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE ..... 3200 VOLTS
DC PLATE CURRENT ..... 0.8 AMPERE
PLATE DISSIPATION ..... 1000 WATTS
GRID DISSIPATION ..... 25 WATTS

1. Bias may be obtained from a fixed supply of 15.8 volts in series with a 9.5 ohm resistor. The resistor and supply should be bypassed for audio frequencies.
2. Approximate.
3. Approximate, and driver must be modulated approximately 83%.

TYPICAL OPERATION
Carrier Conditions, Frequencies to 30 MHz
Cathode Driven

Plate Voltage	2400 Vdc
Cathode Voltage[1]	+22 Vdc
Plate Current	600 mAdc
Grid Current[2]	45 mAdc
Plate Load Resistance	2000 Ω
Driving Power[3]	41 W
Plate Output Power	1000 W
Power Gain	14 dB

APPLICATION

MECHANICAL

MOUNTING - The 8877/3CX1500A7 may be mounted in any position.

SOCKET - The grid of the 8877/3CX1500A7 terminates in the cylindrical grid ring about the base of the tube. This may be contacted by multiple clips or flexible finger stock. Connections to the heater and cathode are made via the 7-pin base.

COOLING - The maximum temperature limit for external tube surfaces and the anode core is 250°C. Tube life is prolonged if these area are maintained at lower temperatures. For full 1500 watts anode dissipation 35.0 cfm of air is required at a back pressure of 0.41" H_2O hold tube temperature below 225°C with 50°C ambient temperature at sea level. At frequencies higher than 30 MHz, or at high altitudes, the air quantity must be increased.

Base-to-Anode Air Flow (sea level)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H_2O
500	7.5	0.10
1000	22.5	0.20
1500	35.0	0.41
Base-to-Anode Air Flow (10,000 ft.)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H_2O
500	11.0	0.15
1000	32.5	0.29
1500	51.0	0.60

Note: 1). Tube mounted in SK-2200 Socket with SK-2216 Chimney.
2). An allowance of 25 watts has been made for grid dissipation and 50 watts for filament power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8877/3CX1500A7 is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent (5%).

INPUT CIRCUIT - When the 8877/3CX1500A7 is operated as a cathode driven rf amplifier, the use of a resonant circuit in the cathode is recommended. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q or five or more.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate potentials over 3000 volts, since plate dissipation may be exceeded. Higher plate voltage may be used with the proper protective bias.

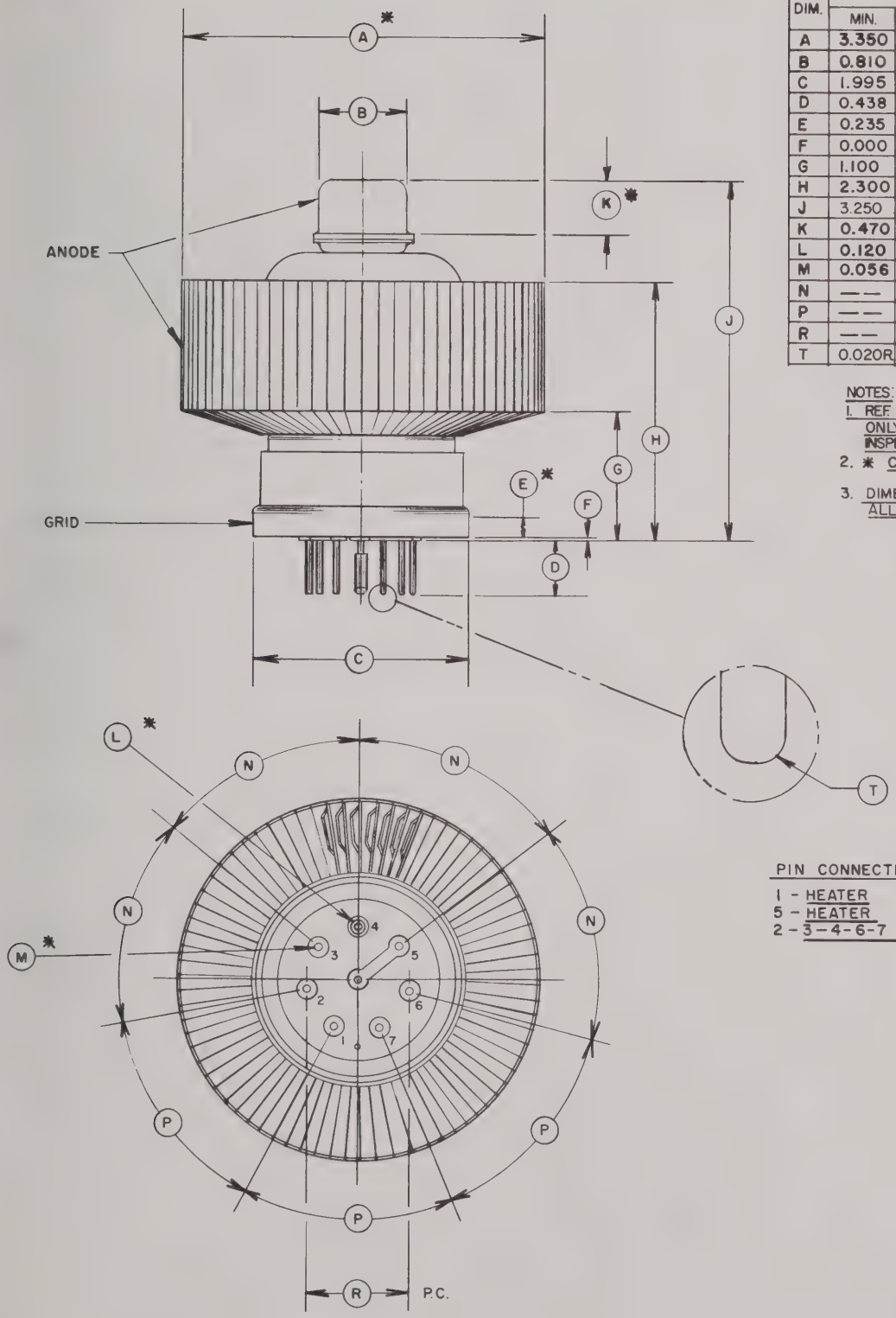
HIGH VOLTAGE - The 3CX1500A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time. Manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, Varian, EIMAC Division, 301 Industrial Way, San Carlos, Calfiornia 94070 for information and recommendations.

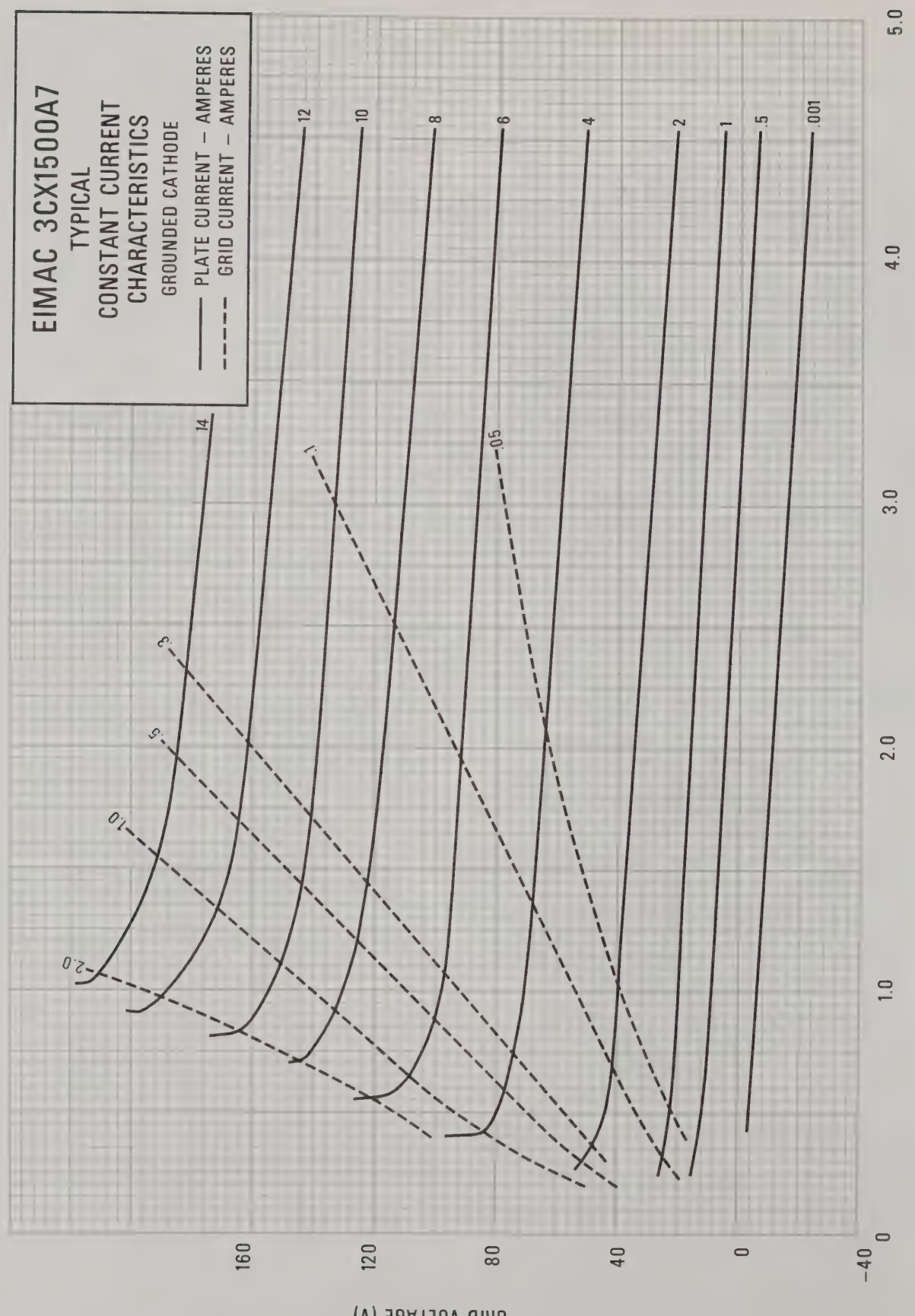


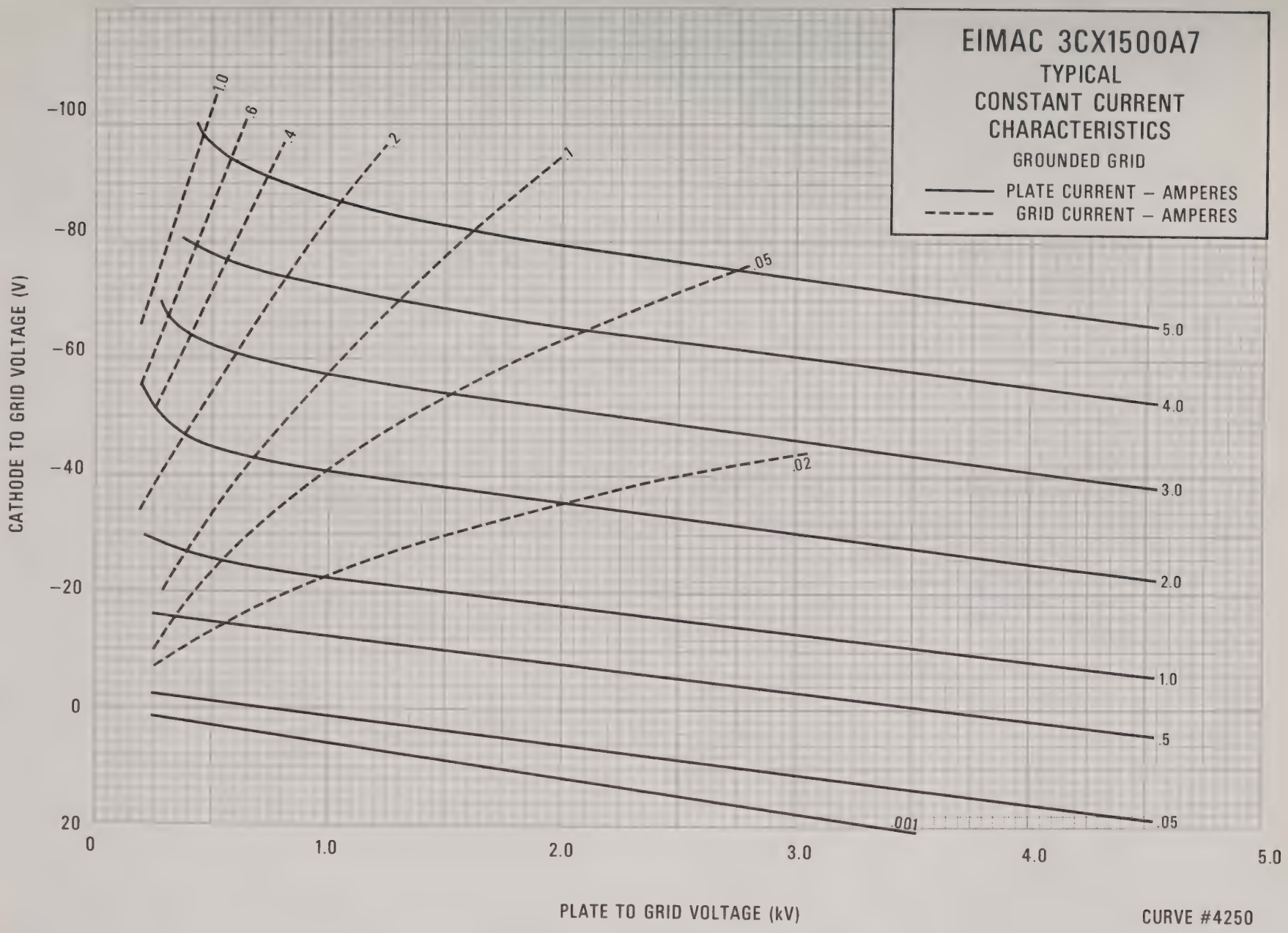
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.350	3.380	— —	85.09	85.85	— —
B	0.810	0.820	— —	20.57	20.83	— —
C	1.995	2.015	— —	50.67	51.18	— —
D	0.438	0.562	— —	11.13	14.27	— —
E	0.235	— —	— —	5.97	— —	— —
F	0.000	0.040	— —	0.00	1.02	— —
G	1.100	1.225	— —	27.94	31.12	— —
H	2.300	2.425	— —	58.42	61.60	— —
J	3.250	3.420	— —	82.55	86.87	— —
K	0.470	0.530	— —	11.94	13.46	— —
L	0.120	0.127	— —	3.05	3.23	— —
M	0.056	0.062	— —	1.42	1.57	— —
N	— —	— —	51°	— —	— —	51°
P	— —	— —	52°	— —	— —	52°
R	— —	— —	1.000	— —	— —	25.40
T	0.020R	— —	— —	0.51R	— —	— —

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. ✱ CONTACT SURFACE
3. DIMENSION T APPLIES TO ALL BUT CENTER PIN.

PIN CONNECTIONS

1 - HEATER
5 - HEATER
2 - 3 - 4 - 6 - 7 CATHODE


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
12
10
8
6
4
2
1
.5
.001
14
2.0
1.0
.5
.3
.1
.05
160
120
80
40
0
–40
0
1.0
2.0
3.0
4.0
5.0
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #4211


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
-100
-80
-60
-40
-20
0
20
1.0
.6
.4
.2
.1
.05
.02
.001
5.0
4.0
3.0
2.0
1.0
.5
.05
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
CURVE #4250

TECHNICAL DATA

8873
8874
8875
HIGH-MU TRIODES



8873



8874



8875

The EIMAC 8873, 8874, and 8875 are compact external-anode ceramic/metal triodes intended for use in Class AB or C amplifiers in radio-frequency applications. The three types differ only in method of cooling and anode dissipation: the anode of the 8873 is designed for conduction cooling and is rated for 200 watts; the 8875 anode has a transverse cooler for forced-air cooling and is rated for 300 watts; and the 8874 requires axial-flow forced-air cooling and is rated for 400 watts. Grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with these types in a cathode-driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater Voltage	6.3 ± 0.3 V
Heater Current, at 6.3 volts	3.0 A
Cathode-Heater Potential (maximum)	±150 V
Tranconductance, average	
Ib = 250 mAdc	29,000 μmhos
Direct Interelectrode Capacitances, (cathode grounded, in shielded fixture)[2]	
Cin	20.5 pF
Cout	0.03 pF
Cgp	6.0 pF
Direct Interelectrode Capacitances, (grid grounded, in shielded fixture)[2]	
Cin	20.5 pF
Cout	6.0 pF
Cpk	0.03 pF
Ck-htr	6.0 pF
Frequency of Maximum Rating:	
CW	500 MHz

1. Characteristics and operating values are based upon peformance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Revised 1-1-77) © 1970, 1971, 1973, 1977 by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:

	TYPE 8873	TYPE 8874	TYPE 8875
Length	2.14 in. 54.41 mm	2.14 in. 54.41 mm	2.18 in. 55.50 mm
Diameter	1.64 in. 41.66 mm	1.64 in. 41.66 mm	2.52 in. 64.01 mm
Net Weight	8.50 oz. 240.9 gm	4.30 oz. 121.9 gm	8.60 oz. 243.8 gm
Operating Position	Any	Any	Any

Cooling: (Type 8873)

Conduction cooled. Recommended Beryllium Oxide thermal link ..... EIMAC SK-1920

(Type 8874)

Air flow at 50°C and sea level ..... 8.6 ft^3/Min.

Pressure Drop, across tube anode cooler at 8.6 ft^3/Min ..... 0.37 in H_20

(Type 8875)

Air flow at 25°C and sea level, and
Pressure Drop across tube anode cooler } See Application Section, Cooling 8875

Operating Temperature, Maximum, all three types,

Ceramic/Metal seals and Anode Core ..... 250°C

Base: (all types) ..... Large Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)

Recommended Sockets ..... E.F.Johnson #124-311-100*

Erie #9802-000

Mycalex #CP464-2

Available grid Collet, for base grid ring contact ..... EIMAC Part No. 882931

*NOTE: The E.F. Johnson socket is available from EIMAC as Part No. 154353.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.
Heater Current, at 6.3 volts	2.8	3.4 A
Cathode Warmup Time	60	--- sec.
Interelectrode Capacitances (cathode grounded, in shielded fixture)[1]		
Cin	18.0	23.0 pF
Cout	---	0.04 pF
Cgp	5.0	7.0 pF
Interelectrode Capacitances (grid grounded, in shielded fixture)[1]		
Cin	18.0	23.0 pF
Cout	5.0	7.0 pF
Cpk	---	0.04 pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION

Class AB_2 (Cathode driven) Peak Envelope Modulation Crest or Key-Down Conditions[1]

Frequency	30	150	432	MHz
Plate Voltage	2000	2000	2000	Vdc
Cathode Voltage	8.2	9.8	8.2	Vdc
Zero-Signal Plate Current	22	10	22	mAdc
Single-Tone IVS Plate Current[2]	500	400	500	mAdc
Two-Tone Plate Current[3]	312	245	300	mAdc
Single-Tone Grid Current[4]	30	23	98	mAdc
Two-Tone Grid Current[4]	12	10	39	mAdc
Peak rf Grid/Cathode Voltage[4]	67	50	67	v
Peak Driving Power[4]	26	17.5	27	w
Peak Power Input	1000	800	1000	W
Useful Output Power[4]	587	526	505	W
Resonant Load Impedance	2140	--	--	Ω
Intermodulation Distortion[5]				
3rd Order	-35	--	--	dB
5th Order	-36	--	--	dB

1. Short-term duty should not exceed 50%. During brief test periods, "on" time must be kept as short as possible, with sufficient "off" time to allow for tube cooling.
2. Key down condition. With 50% duty, current will be half the value shown.
3. Two equal-tone modulation. During brief test periods, allow sufficient "off" time for tube cooling. Values will be lower with voice modulation for the same PEP level.
4. Approximate values.
5. The intermodulation distortion products are referenced against one tone of a two equal-tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	2000	Vdc
Grid Voltage[1]	-10	Vdc
Plate Current	250	mAdc
Grid Current[1]	40	mAdc
Measured Driving Power	9	WATTS
Plate Input Power	500	WATTS
Plate Dissipation	195	WATTS
Useful Output Power	305	WATTS

1. Approximate value.

PULSE MODULATOR OR REGULATOR

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
PEAK ANODE CURRENT	6	AMPERE
GRID DISSIPATION	5	WATTS

PLATE DISSIPATION (nominal values):

TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS

APPLICATION

MOUNTING & SOCKETING - The 8873, 8874, and 8875 may be mounted in any position. Sockets such as E.F. Johnson #124-311-100, Erie #9802-000, Mycalex #CP464-2, or equivalent may be used as long as there are no unusual circumstances which would allow the ceramic/metal anode and base seal temperatures to exceed 250°C. The internal construction of these tubes is such that heat transfer to the tube base is minimized, but in operation there is some heat flow from the tube base to the socket. Mounting should be such that free movement of air past the base by convection is possible, or, if forced-air cooling is being provided for the anode, some of this air may be bled off to provide for some circulation past the tube base.

The 8873 mounting is normally controlled by its heat sink configuration and location. Where possible, the socket can be mounted on a bracket which in turn is mounted to the heat sink so that the one sink will act for removal of heat from the tube anode and also the tube base. The EIMAC SK-1920 beryllium oxide (BeO) thermal link is available for use between the 8873 anode and the heat sink. BeO is a ceramic material which exhibits high thermal conductance, similar to aluminum, and high electrical resistance and low loss typical of ceramics. Properly installed, it provides a low thermal resistance path allowing the anode heat to be transferred to the heat sink, while providing electrical isolation between the anode and the sink.

The 8874 requires forced-air cooling for its anode, which can often be accomplished most easily by means of a pressurized anode-compartment chassis, with air passing through the anode cooler and then exhausting. In such an installation, some air can be bled past the socket mount to provide base cooling if this is required.

The 8875 has a large transverse cooler on its anode, requiring forced-air cooling directed crossways.

HEATER/CATHODE OPERATION - The rated heater voltage for the 8873, 8874, and 8875 is 6.3 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long life and consistent performance. At frequencies above approximately 300 MHz it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid-bias, anode current, duty cycle, and circuit design and adjustment. The following heater operating voltages are recommended:

Frequency (MHz)	Heater Voltage
300 or lower	6.3
301 to 400	6.0
401 to 500	5.7

The potential between the heater and the cathode should be limited to plus or minus 150 Vdc.

CATHODE WARMUP TIME - In normal service it is recommended that the heater voltage be applied for a minimum of 60 seconds before anode voltage and drive boltage are applied, to allow proper conditioning of cathode surface.

If it is desired to apply anode voltage simultaneously with heater voltage, enough bias voltage must also be applied so that no conduction can take place until drive voltage is applied after the full 60 seconds of warmup time.

ANODE CURRENT RATING AND TUNEUP PROCEDURE - The 8873, 8874, and 8875 are rated for 250 mAdc of continuous anode current. In intermittent voice (A3J emission) and interrupted carrier keying (A1 emission) service, which would be normal single-sideband-suppressed-carrier or keyed CW operation, and where short-term duty does not exceed 50%, the dc anode current (per tube) may be 500 mA during the "on" time. With 50% duty, the average current (per tube) would be 250 mA. During very short test periods, the tubes may be operated at full 500 mA value but care must be taken to keep the "on" time as short as possible, with sufficient "off" time to allow for tube cooling.

Initial tuneup should preferable be done with reduced anode voltage and drive, and if done at the correct values, little or no retuning will be necessary when switching to full operating level. For the 2000 volt Intermittent Voice Service (IVS) condition, tuneup is recommended at 1500 volts and reduced grid drive. When anode voltage and drive are then raised, the full one kilowatt PEP IVS condition will be achieved with little or no retuning required.

COOLING - 8873 - This tube is designed for use in a conduction-cooled system by using a beryllium oxide (BeO) thermal link between the anode and the heat sink. The heat sink in turn can be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. The design choice is determined by the tube application, but in all cases the cooling system must maintain the anode and the ceramic-metal seal temperatures below 250°C.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode through the BeO thermal link to the heat

sink. A good thermally conductive compound should be used in the interface (between anode and BeO, and between BeO and heat sink) to reduce the thermal resistance of the joint. Examples of commercially available thermal joint compound are:

WAKEFIELD 120 - Wakefield Engineering Co., Wakefield, Mass. 01880
DOW CORNING 340 - Dow Corning Corp., Midland, Michigan 48640
ASTRODYNE THERMAL BOND 312 - Astrodyne Inc., Burlington, Mass 01803
G.E. INSULGREASE G641 - G.E. Company, Cleveland, Ohio 44117

The method of fastening the tube to the heat sink should provide reasonable compression to reduce interface thermal resistance. A device such as the DE-STA-CO toggle clamp, modified by replacing the rubber nose with a ½-inch ceramic insulator, can provide a simple means of holding the tube securely and providing adequate compression.

The EIMAC SK-1920 BeO thermal link is recommended for use between the tube anode and the heat sink, as it is the correct size and thickness to match the physical and electrical characteristics of the 8873 tube.

IMPORTANT - BEFORE HANDLING OR ATTEMPTING TO USE ANY BERYLLIUM OXIDE THERMAL LINK CAREFULLY READ THE MATERIAL ON PAGE 6 REGARDING THIS MA—TERIAL.

A heat sink capable of handling 200 watts of continuous dissipation from the 8873 can be made with a section of finned aluminum alloy extrusion, such as Wakefield A-2494, or equivalent, cut to approximately 8 inches by 4 inches, backed with a ⅛-inch copper plate the same size. Thermal joint compound is used between the copper plate and the flat aluminum surface, with the two secured together at enough points to assure good continuous contact. The backed extrusion is mounted so as to allow for free air convection around the fins. The tube is then mounted, with the EIMAC SK-1920 thermal link, in the approximate center of the copper surface, with thermal joint compound again used between the tube anode and the BeO link, and between the BeO link and the copper. A device such as the modified DE-STA-CO toggle clamp is used to hold the tube securely in place.

Socketing is accomplished with one of the units mentioned earlier, mounted so as to allow for free air convection around the base of the tube and the socket, and on a bracket which returns to the same heat sink if possible. The designer is cautioned to allow for some lateral movement in the socket mount, and to make sure the anode is flat against the BeO thermal link so that good conduction contact exists before the socket mounts are tightened down. If the tube anode, the thermal link, and the heat sink are not making good flat contact, heat transfer will be seriously affected.

If unusually high ambient temperatures are expected, or more than 200 watts capability is required, a small fan can be used to move air past the sink cooling fins. With any conduction-cooled power tube, dissipation capability is almost completely dependent on the ability of the heat-sink system to carry heat away and the temperature limitations of the tube itself. Thus the 200-watt dissipation rating of the 8873 is a nominal value only, as illustrated by the fact that the same tube, with an axial-flow air radiator installed (the 8874) is rated for 400 watts of dissipation under specified cooling conditions.

In all cases, temperature of the tube anode and the ceramic/metal seals is the limiting factor, and the equipment designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

8874 -Forced-air cooling must be provided to maintain the anode core and seal temperatures within maximum rating. The cooling data shown is for sea level, with cooling air at 50°C, and is sufficient to limit tube temperatures to 225°C. The pressure drop figures shown are for the anode cooler only, as would be the case with a pressurized anode compartment of an equipment, where air would be required to pass through the anode cooler and then through an insulated duct to the outside of the cabinet. Some air from the pressurized anode compartment can be bled by the socket for base cooling, either by means of a somewhat oversize socket-mounting hole, or a series of small holes drilled in the chassis near the edges of the socket, in order to provide a small amount of air circulation around the base pins of the tube.

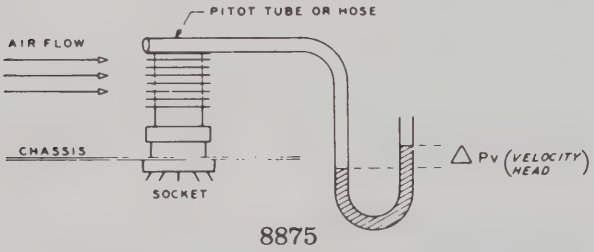
8874

Anode Diss.	Air Flow (CFM)	Approx. Press. Drop (In. H_20)
200W	4.0	0.11
300W	6.0	0.22
400W	8.6	0.37

8875 - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. Cooling data is shown for sea level, with cooling air at 25°C.

These figures are for the case where the cooling air is supplied from a small general-purpose fan in close proximity to the tube and directing air across the tube and through the anode cooler.

The recommended cooling is sufficient to limit tube temperatures to 225°C. The required air velocity can be checked with a simple manometer, as shown in the accompanying figure.



8875

Anode Diss.	Cooling Air Velocity	Vel. Head (Δ Pv) Inches of H_20
200W	870 Ft/Min.	0.045
300W	1600 Ft/Min.	0.16

With all three tube types, the equipment designer is cautioned that it is not good practice to operate at, or close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined here is normally beneficial.

DANGER - BERYLLIUM OXIDE CERAMICS (Be0) Do not alter, grind, lap, fire, chemically clean, or perform any other operation on the SK-1920 Beryllium Oxide thermal link used with the 8873, or any other equivalent section of Be0 used with the 8873. Normal use of Be0 ceramics has never been considered hazardous, but the user should avoid any operation which would create Be0 dust particles in the air, or fumes, which could be breathed, as these are considered dangerous.

It should be noted that none of these three tubes contains any Be0 in the envelope, or internally. Only the SK-1920 thermal link is made of Be0, because of its insulating qualities combined with its high thermal conductivity.

HIGH VOLTAGE - The 8873, 8874, and 8875 operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

OUTPUT CAPACITANCE - The interelectrode capacitance figures given in the General Characteristics are measured in a shielded fixture and do not include additonal external capacitance. Including the stray capacitance between the anode and the heat sink used with the 8873 tube will typically raise the output capacitance to somewhat more than double the measured internal value.

INTERMODULATION DISTORTION - Typical Operating Conditions, with distortion values included, are the result of data taken during actual operation a 2 Megahertz. Intermodulation values listed are those measured at the full peak envelope power noted and are referenced against one tone of a two-equal tone signal.

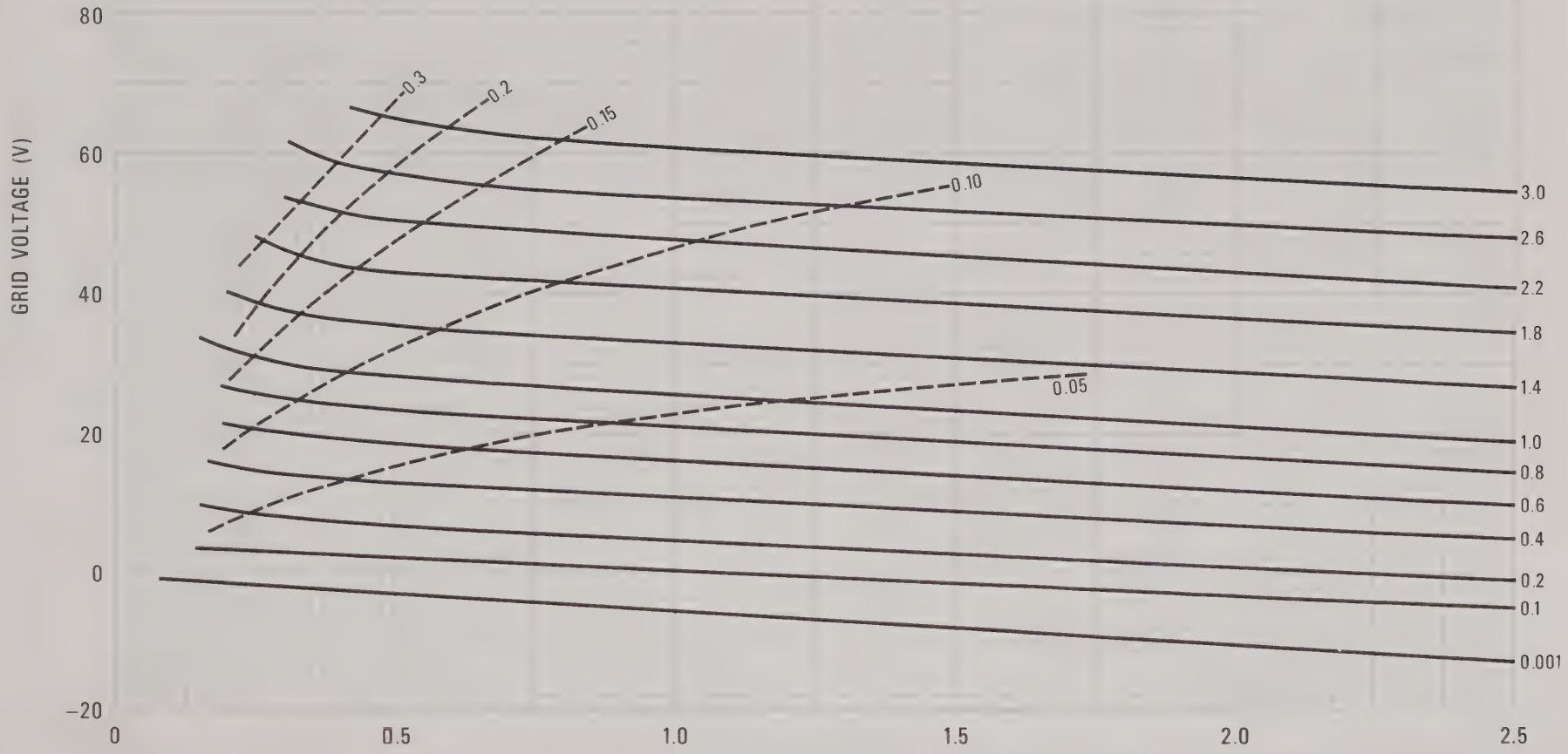
INPUT CIRCUIT - When any of these types is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

SPECIAL APPLICATIONS - It it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE

——— PLATE CURRENT – AMPERES – – – – GRID CURRENT – AMPERES

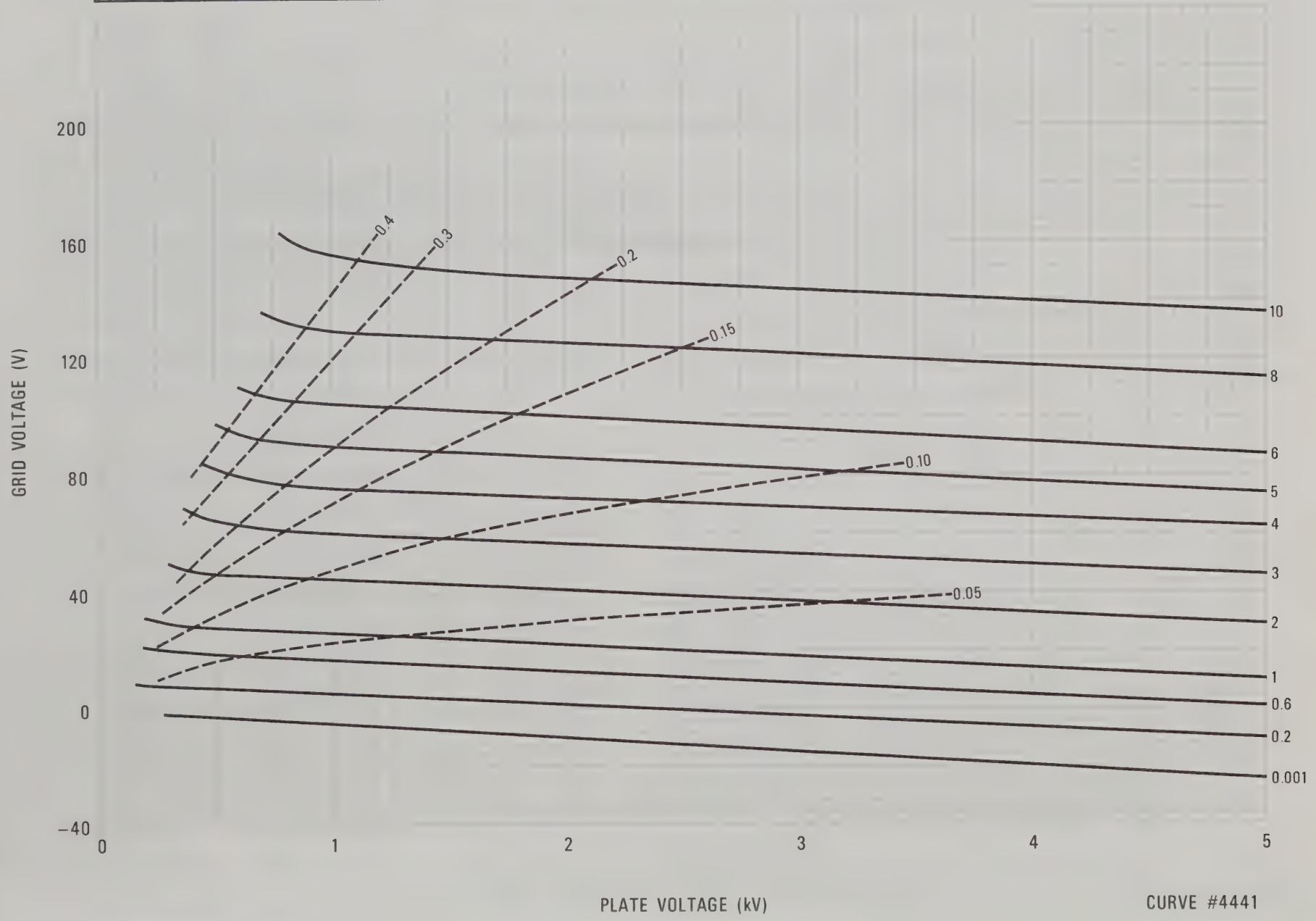


CURVE #4440

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE

——— PLATE CURRENT – AMPERES – – – – GRID CURRENT – AMPERES

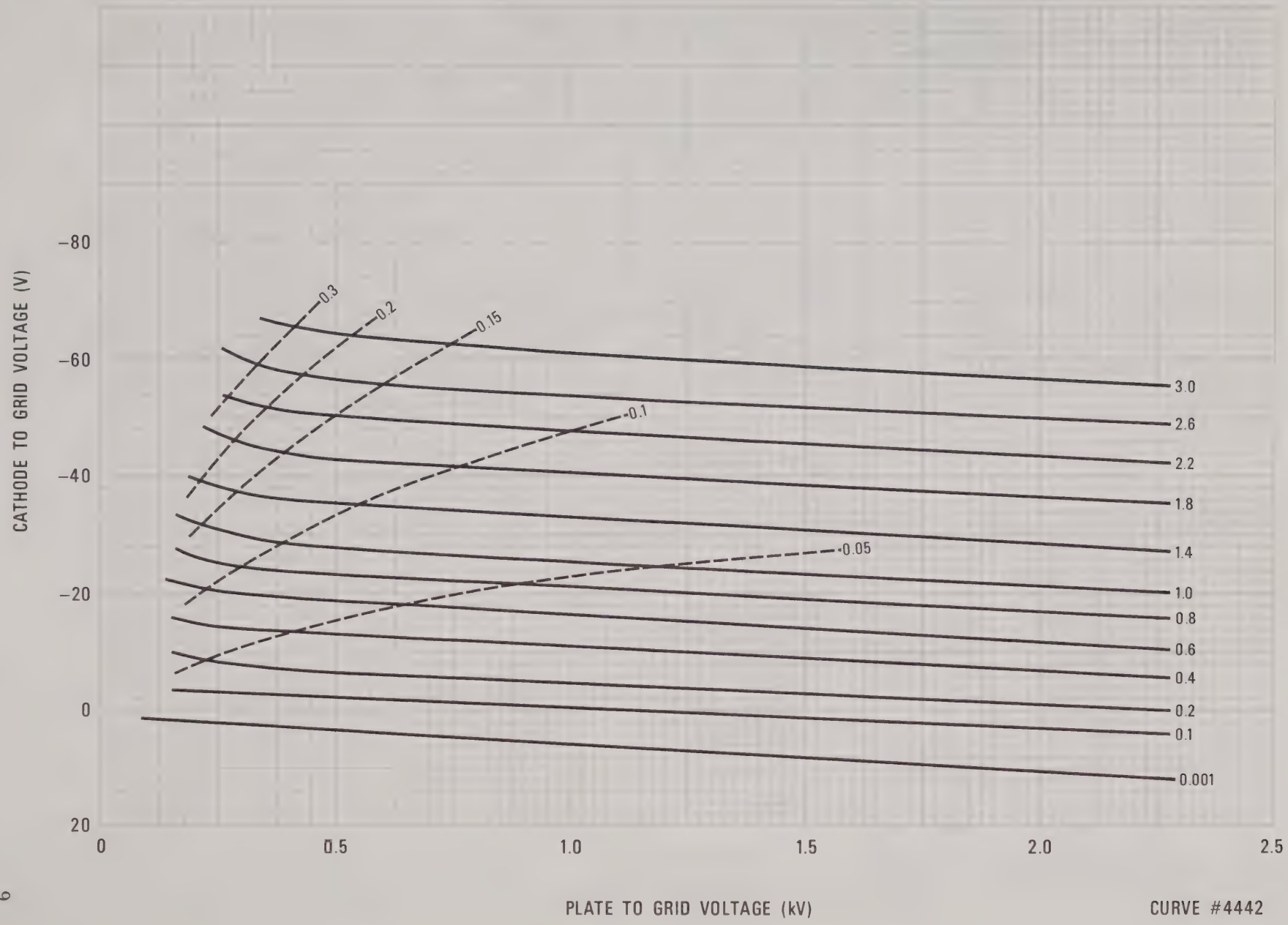


CURVE #4441

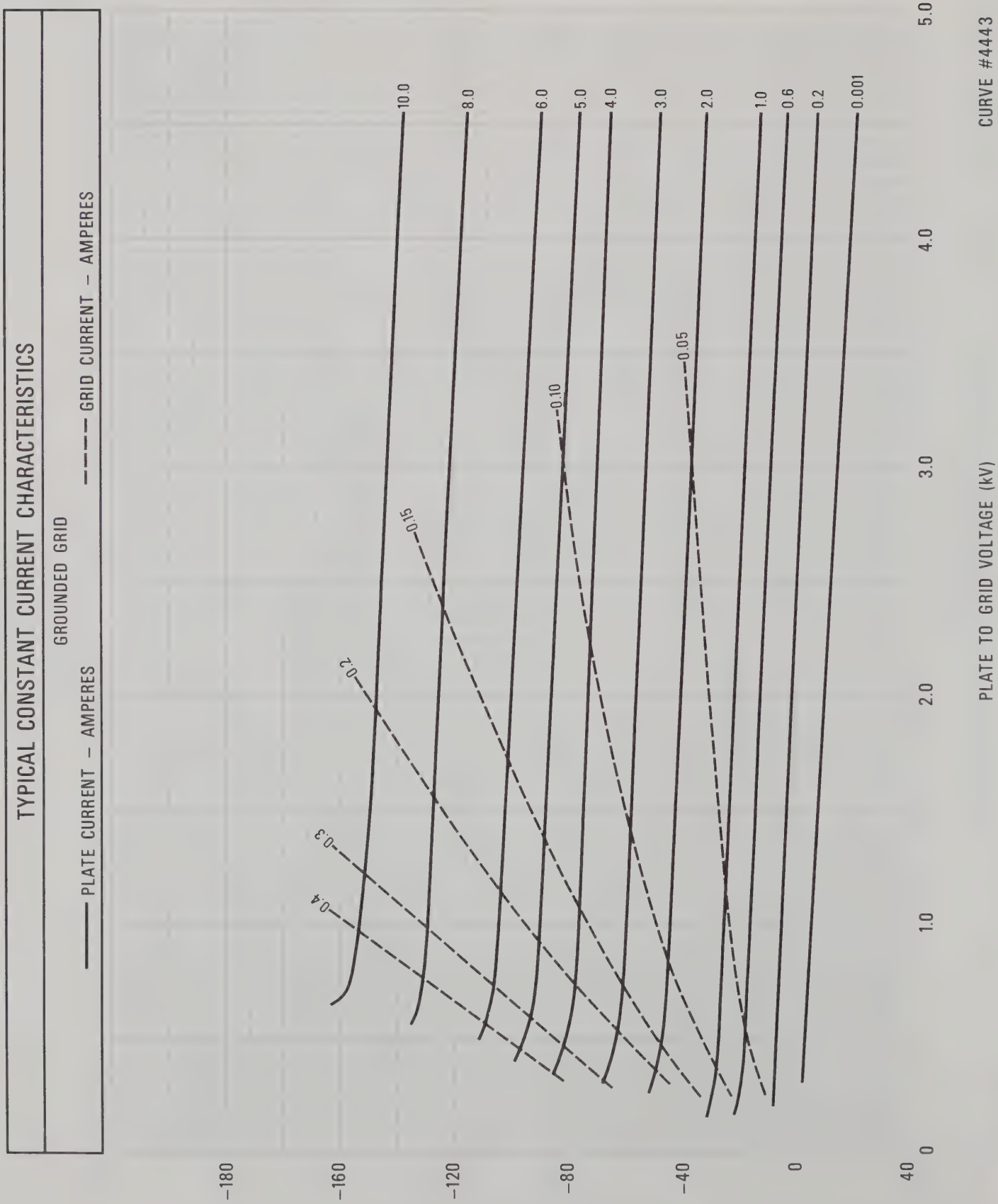
TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED GRID

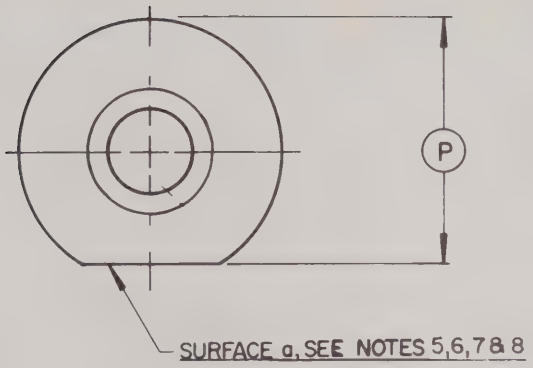
——— PLATE CURRENT – AMPERES – – – – GRID CURRENT – AMPERES



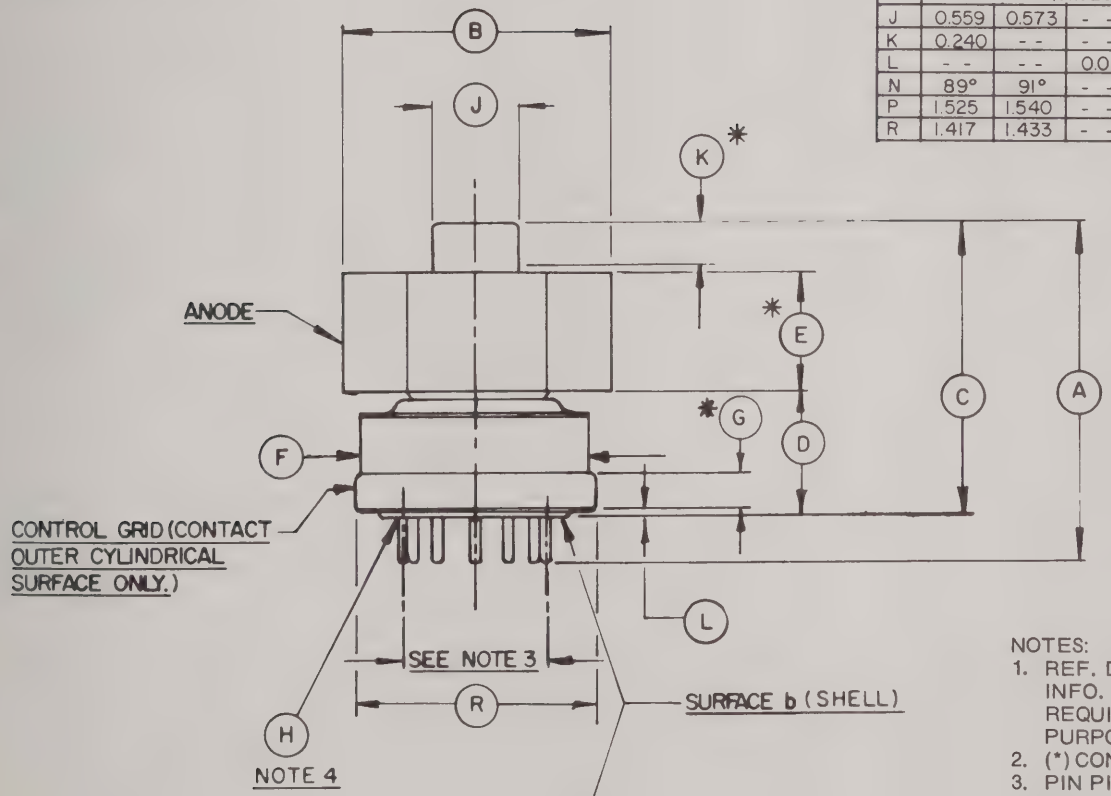
CURVE #4442

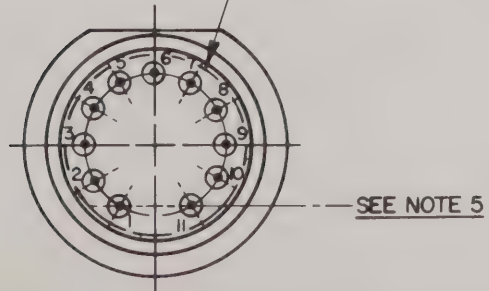

TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
2.0
0.15
0.10
0.05
0.3
0.4
CATHODE TO GRID VOLTAGE (V)
-180
-160
-120
-80
-40
0
40
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
CURVE #4443

PIN NO. 1 CATHODE
PIN NO. 2 CATHODE
PIN NO. 3 CATHODE
PIN NO. 4 CONTROL GRID
PIN NO. 5 HEATER
PIN NO. 6 HEATER
PIN NO. 7 CONTROL GRID
PIN NO. 8 CATHODE
PIN NO. 9 CATHODE
PIN NO. 10 CATHODE
PIN NO. 11 CONTROL GRID



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
N	89°	91°	- -	89°	91°	- -
P	1.525	1.540	- -	38.73	39.12	- -
R	1.417	1.433	- -	35.99	36.40	- -



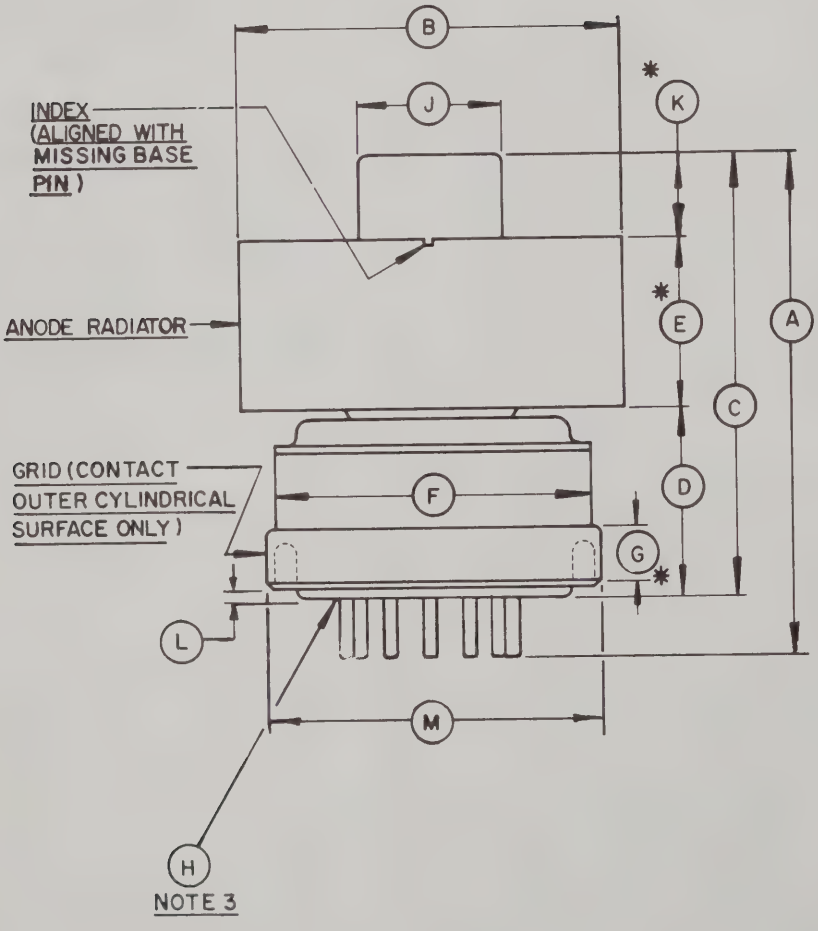


8873

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.
5. SURFACE a TO BE PARALLEL TO PINS I & II AXIS WITHIN 2° & ON OPPOSITE SIDE.
6. SURFACE a MUST BE FLAT WITHIN .001 & PERP. TO SURFACE b WITHIN N LIMITS.
7. SURFACE a TO BE FREE OF ANY CODING OR LABELING.
8. SURFACE a ROUGHNESS (ASA B46.1-1962 OR ISO R468-66) — 32 μin. 6.8 μm.

PIN No.1: CATHODE
PIN No.2: CATHODE
PIN No.3: CATHODE
PIN No.4: GRID
PIN No.5: HEATER
PIN No.6: HEATER
PIN No.7: GRID
PIN No.8: CATHODE
PIN No.9: CATHODE
PIN No.10: CATHODE
PIN No.11: GRID

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
M	1.417	1.433	- -	35.99	36.40	- -

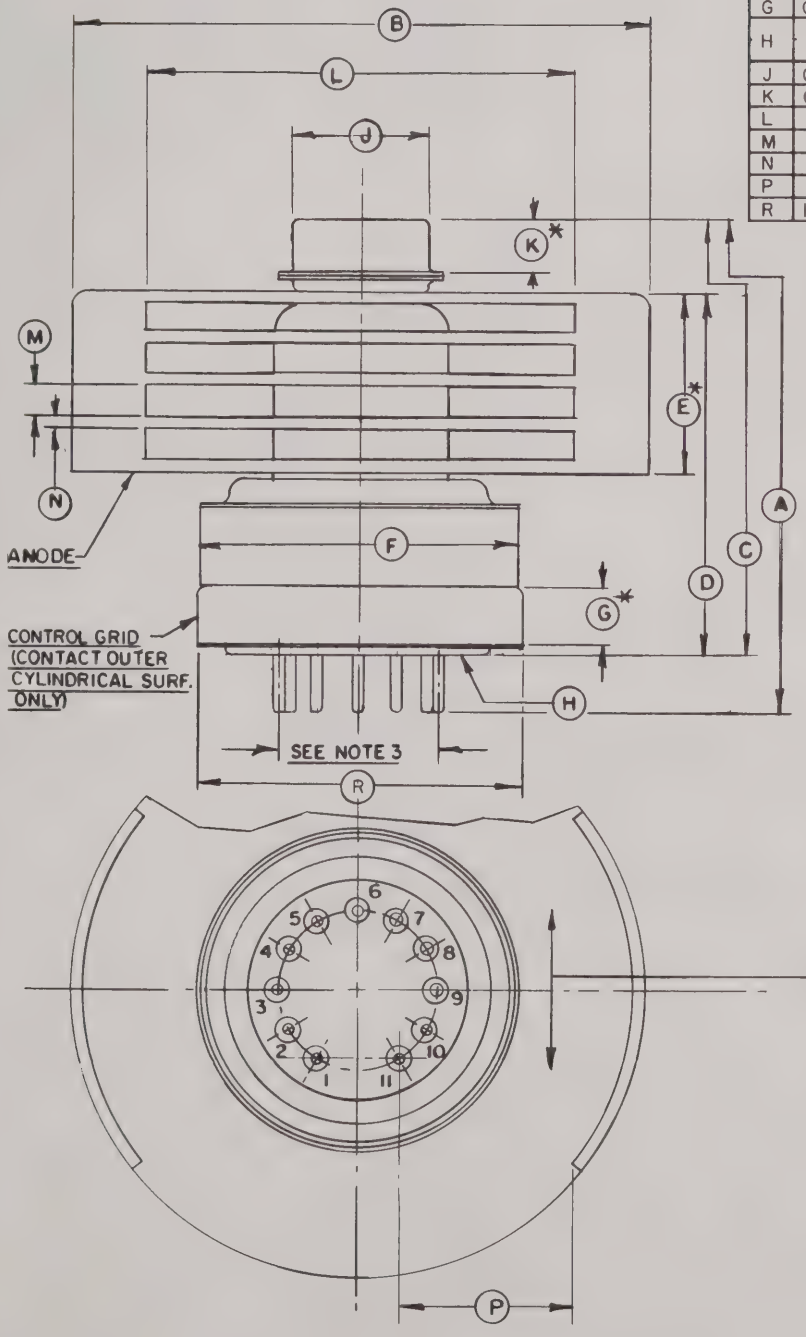


NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.
3. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL

8874

PIN No.1,2,3,8,9,10	CATHODE
PIN No.4,7,11	CONTROL GRID
PIN No.5,6	HEATER

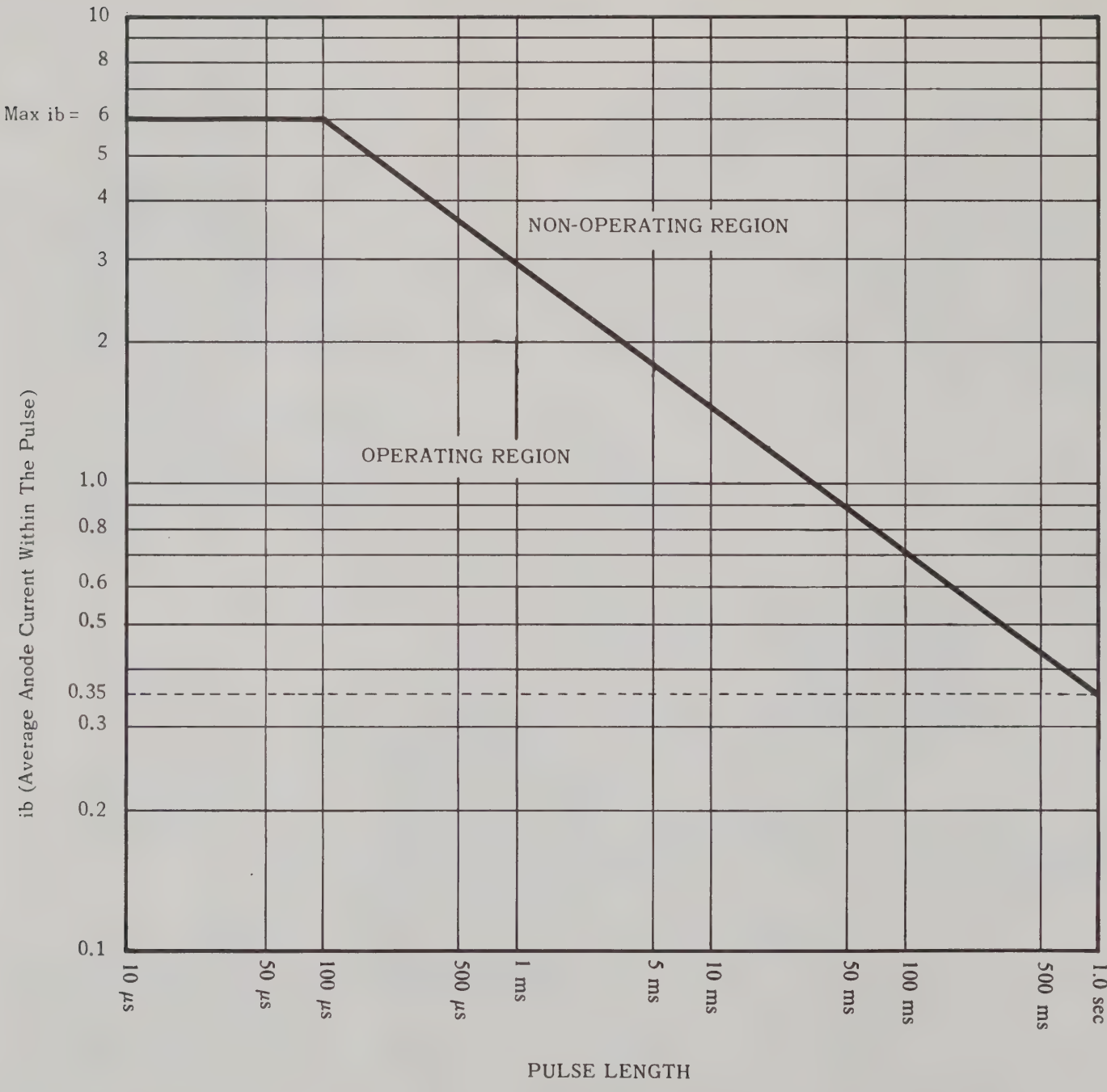
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	2.185	- -	- -	55.50	- -
B	2.480	2.520	- -	62.99	64.01	- -
C	1.867	1.997	- -	47.42	50.72	- -
D	1.514	1.644	- -	38.46	41.76	- -
E	0.750	0.830	- -	19.05	21.08	- -
F	- -	- -	1.406	- -	- -	35.71
G	0.187	- -	- -	4.75	- -	- -
H	BASE E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	2.000	- -	- -	50.80	- -
M	- -	- -	0.135	- -	- -	3.43
N	- -	- -	0.050	- -	- -	1.27
P	- -	- -	0.560	- -	- -	14.22
R	1.417	1.433	- -	35.99	36.40	- -



NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (X) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.

8875



Pulse anode current (ib) capability is dependent on pulse length (tp) and duty factor (Du). Maximum ib for a given tp is shown; maximum Du may then be derived from the relationship: $0.350 = ib \sqrt{Du}$

PULSE DERATING CHART, TYPES 8873, 8874, 8875

PULSE MODULATOR OR REGULATOR SERVICE

TECHNICAL DATA

X-2159

WATER-COOLED
POWER TETRODE

The EIMAC X-2159 is a ceramic/metal water-cooled power tetrode designed for very-high-powered medium-frequency broadcast service and very-low-frequency communication in the megawatt power range.

The X-2159 has a two-section thoriated-tungsten filament mounted on water-cooled supports. The two sections may be fed in quadrature to reduce hum contributed by an ac power source, or it may be operated with dc power. The maximum anode dissipation rating is 1250 kilowatts steady state.

Large-diameter coaxial terminals are used for the control grid and the rf filament terminal. Filament power and filament support cooling-water connections are made through three special couplings.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten, two-section	
Voltage, per section (See FILAMENT OPERATION section)	18.5 + 0.9 V
Current, @ 18.5 V per section	650 A
Amplification Factor (average), Grid to Screen	4.5
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	1600 pF
Cout	250 pF
Cgp	6 pF
Frequency of Operation: for use above 30 MHz contact: Product Manager, High Power Tubes, Varian, EIMAC Division	

1. The design of this tube is subject to change. The data supplied is for guidance only. Before establishing a final equipment design with this tube, contact: Product Manager, High Power Tubes, Varian, EIMAC Division.

2. Capacitance values shown are nominal, measured with no special shielding.

MECHANICAL

Maximum Overall Dimensions:	
Length (including lifting eye)	25.50 in; 64.78 cm
Diameter	17.03 in; 43.26 cm
Net Weight	175 lbs; 80 kg
Operating Position	Vertical, base down
Cooling	Water and Forced Air
Base Terminals	Special
Recommended Filament Connectors (not supplied with tube):	
Filament Power/Water Connector (3 required)	EIMAC SK2310
Filament rf Connector (1 required)	EIMAC SK2315
Maximum Operating Temperature (Envelope & Ceramic/Metal Seals)	200°C

(Effective 5-1-77)

© 1973, 1977 by Varian

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC GRID VOLTAGE	-1.0 KILOVOLT
DC PLATE CURRENT	125 AMPERES
PLATE DISSIPATION	1250 KILOWATTS
SCREEN DISSIPATION	15 KILOWATTS
GRID DISSIPATION	4.0 KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB1, Peak Envelope Conditions

Plate Voltage	20.0	kVdc
Screen Voltage	1500	Vdc
Grid Voltage[1]	-380	Vdc
Zero Signal Plate Current	20.0	Adc
Single Tone Plate Current	86.5	Adc
Single Tone Screen Current[2]	3.8	Adc
Peak rf Grid Voltage[2]	380	v
Plate Dissipation	505	kW
Plate Load Resistance	132.2	Ω
Plate Power Output	1225	kW
Efficiency	70.8	%

1. Adjust to specified zero-signal plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

(Key-down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5 KILOVOLTS
DC SCREEN VOLTAGE	2.5 KILOVOLTS
DC GRID VOLTAGE	-2.0 KILOVOLTS
DC PLATE CURRENT	125 AMPERES
PLATE DISSIPATION	1250 KILOWATTS
SCREEN DISSIPATION	15 KILOWATTS
GRID DISSIPATION	4.0 KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	21.5	kVdc
Screen Voltage	1000	Vdc
Grid Voltage	-700	Vdc
Plate Current	125	Adc
Screen Current[1]	12	Adc
Grid Current[1]	7.2	Adc
Calculated Driving Power	7.0	kW
Plate Dissipation[1]	530	kW
Screen Dissipation[1]	12	kW
Grid Dissipation[1]	1.9	kW
Plate Load Resistance	85.5	Ω
Plate Power Output	2158	kW
Efficiency	80.1	%

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER Class C Telephony

(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17.5 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	-2.0 KILOVOLTS
DC PLATE CURRENT	100 AMPERES
PLATE DISSIPATION	800 KILOWATTS
SCREEN DISSIPATION	15 KILOWATTS
GRID DISSIPATION	4.0 KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	17.5	kVdc
Screen voltage	1000	Vdc
Grid Voltage	-1000	Vdc
Plate Current	95.0	Adc
Screen Current[1]	8.0	Adc
Grid Current[1]	4.4	Adc
Peak Screen Voltage (100% Mod)	1000	v
Peak rf Grid Voltage	1280	v
Calculated Driving Power	6465	W
Plate Dissipation	279	kW
Screen Dissipation[1]	8.0	kW
Grid Dissipation[1]	2.05	kW
Plate Load Resistance	85.6	Ω
Plate Output Power	1384	kW
Efficiency	83.3	%

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Doherty Linear Amplifier Service

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC GRID VOLTAGE	-2.0	KILOVOLTS
DC PLATE CURRENT	125	AMPERES
PLATE DISSIPATION	1250	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Peak Tube - Peak of Modulation

DC Plate Voltage	19.0	kVdc
DC Screen Voltage	1600	Vdc
DC Grid Voltage[1]	-1800	Vdc
Peak Grid Drive Voltage	2220	v
Peak Grid Drive Power[1]	10	kW
Peak Plate Power Output[1]	2750	kW
Plate Load Resistance	51.5	Ω

1. Approximate value.

Carrier Tube - Carrier Conditions

DC Plate Voltage	19.0	kVdc
DC Screen Voltage	1600	Vdc
DC Grid Voltage[1]	-400	Vdc
DC Grid Current[1]	0.14	Adc
DC Screen Current[1]	7.3	Adc
DC Plate Current	101	Adc
Peak Grid Drive Voltage[1]	443	v
Grid Driving Power[1]	65	W
Plate Power Output[1]	1380	kW
Plate Dissipation[1]	510	kW
Plate Efficiency	71	%
Plate Load Resistance	102	Ω

Carrier Tube - Peak of Modulation

Peak Grid Drive Voltage	668	v
Peak Grid Driving Power	1090	W
Plate Power Output	2750	kW
Plate Load Resistance	51.5	Ω

Actual Load Resistance at Combining Point=25.7 Ω

Screen Dissipation Averaged over a Sinusoidal Modulation Cycle of Modulation - Index 1

Carrier Tube	14.0	kW
Peak Tube	8.5	kW

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	22.5	KILOVOLTS
DC SCREEN VOLTAGE	2.5	KILOVOLTS
DC GRID VOLTAGE	-1.0	KILOVOLTS
DC PLATE CURRENT	125	AMPERES
PLATE DISSIPATION	1250	KILOWATTS
SCREEN DISSIPATION	15	KILOWATTS
GRID DISSIPATION	4.0	KILOWATTS

TYPICAL OPERATION Two Tubes - Sinusoidal Wave

Plate Voltage	17.5	kVdc
Screen Voltage	1500	Vdc
Grid Voltage[1]	-455	Vdc
Zero Signal Plate Current	10	Adc
Maximum Signal Plate Current	146.2	Adc
Maximum Signal Screen Current[2]	7.8	Adc
Peak Audio Frequency Grid Voltage[3]	455	v
Maximum Signal Plate Dissipation[3]	275	kW
Plate/Plate Load Resistance	238.5	Ω
Plate Output Power	2015	kW

1. Adjust for stated zero-signal plate current.
2. Approximate value.
3. Per Tube.

NOTE: TYPICAL OPERATION data are obtained by calculation from the published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power then the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

APPLICATION

MECHANICAL

MOUNTING - The X-2159 must be mounted vertically, base down. The full weight of the tube should rest on the main screen-grid contact flange at the base of the tube, and all lifting of the tube should be done with the lifting eye which is attached to the top of the anode cooling jacket.

COOLING - Minimum cooling water requirements for the anode are shown in the table, for an outlet water temperature not to exceed 70°C and an inlet water temperature of 50°C. System pressure should not exceed 100 psi. High-purity water must be used to minimize power loss, corrosion of metal fittings, and loss of anode dissipation capability. Water resistivity must be maintained at 1 megohm/cm^3 or better for long term operation.

Anode Dissipation (kW)	Water Flow (gpm)	Apprx.Jacket Press.Drop (psi)
500	130	25
1000	250	75
1250	300	100

EIMAC APPLICATION BULLETIN # 16 should be consulted for details on maintenance of water quality standards and use of a water purification loop in the installation. Since the anode is normally at high potential to ground, water connections to the anode are made through insulating tubing, with long enough sections that column resistance is above 4 megohms per 1000 plate supply volts, or 10 megohms total, whichever is less.

The tube base requires air cooling, with a minimum of 50 cfm of air at 50°C maximum at sea level directed toward the base seal areas from a general purpose fan.

Water cooling of the filament and screen grid supports is also required, with inlet water temperature not to exceed 50°C. Each of the 3 filament connectors includes both an inlet and outlet line, with the proper section for the inlet water shown on the outline drawing. Minimum flow for the F1 and F3 connectors is 1.0 gpm, at an approximate pressure drop of 15 psi each. Minimum flow for the F2 connector is 4.0 gpm, at an approximate pressure drop of 55 psi. The screen grid cooling water is fed by means of the ¼-18 NPT tapped holes shown on the outline drawing, with a minimum flow of 2.0 gpm required, at an approximate pressure drop of 25 psi.

All cooling must be applied before or simultaneously with the application of electrode voltages, including the filament, and should be maintained for at least two minutes after all voltages are removed to allow for tube cooldown.

As regards base air cooling, temperatures of the ceramic/metal seals and the lower envelope areas are the controlling and final limiting factor. Temperature-sensitive paints are available for use in checking temperatures in these areas before equipment design and air-cooling arrangements are finalized.

ELECTRICAL

FILAMENT OPERATION - Filament turn-on and turn-off should be programmed in accordance with a special procedure. Filament voltage should be smoothly increased from zero to the operating level over a period of two minutes, and a motor-driven VARIAC or POWERSTAT is suggested. Inrush current must never be allowed to exceed twice normal operating current. Turnoff procedure should be a smooth decrease from the operating voltage to zero over a period of two minutes, such as would be provided by a motor-driven VARIAC, POWERSTAT, or solid state regulator circuit.

Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal voltage variations of ±5% are tolerable and should have little effect on the electrical performance of the tube. When very long life and consistent performance are factors, the filament voltage can often be reduced to a lower value than the nominal, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable a typical procedure would involve a one-to-one regulating transformer feeding a variable-ratio transformer, which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage, and when stable operation is achieved the voltage is then reduced in small steps until a point is reached where performance of the tube is clearly affected. The voltage is then raised a few tenths of a volt above this level for operation. Periodically the procedure should be repeated and the operating value of filament voltage readjusted if necessary. This value is normally 16.5 to 17.0 Vrms (initially).

Where hum is an important system consideration it may be necessary to operate the filament with dc rather than ac power, or provide suitable hum-bucking circuits.

Care should be exercised to keep any rf power out of the filament of the tube, as this can cause excessive operating temperatures. A HEWLETT—PACKARD Vector Impedance meter is useful in detecting the presence of impedance that will support rf buildups in the filament "backcavity" circuit.

VACION® PUMP OPERATION - The tube is supplied with an ion pump and magnet mounted inside the filament structure at the base (stem) of the tube. A power supply (Varian Part #921-0015) and cable (8 feet long, Varian Part #924-0020) are required for operation.

It is recommended that the VACION® pump be operated continuously when the tube is in its operating socket.

During storage of the tube it is also recommended the ion pump be operated continuously if possible; otherwise it should be operated at least once a year until the indicator meter shows 1.0μA or less of current.

ABSOLUTE MAXIMUM RATINGS — The values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation, load variation, or manufacturing variations in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

GRID OPERATION — The X-2159 grid is rated at 4000 watts of dissipation. Protective measures should be included in the circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of the dc grid current and peak positive grid voltage.

SCREEN OPERATION — Base cooling (air and water) must be on and at the correct level before tube operation is started. The power applied to the screen grid must not exceed 15 kilowatts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of rms screen current and rms screen voltage.

Plate voltage, plate load, or grid bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective circuitry must be provided to remove screen power in case of such a fault condition. Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design and operating conditions. The screen supply voltage must be maintained constant for any values of negative or positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished by use of a shunt regulator circuit in the screen voltage supply, bleeder resistors, or other suitable techniques.

PLATE OPERATION - The maximum dissipation rating of the X-2159 is 1250 kilowatts with water cooling. When used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 800 kilowatts.

Specified anode dissipation ratings assume 10 kilovolts maximum anode voltage during conduction. If full rated dissipation at a tube drop greater than this value for periods greater than 200 milliseconds is desired, contact EIMAC Application Engineering.

FAULT PROTECTION — To assure nondestruction of tube elements from high-energy power supplies, during a fault condition, all supplies must be checked for proper operation of their protective circuits. An approved method to meet the tube protection criteria would be the use foil, solder wire, or small diameter wire to produce a controlled short on the power supply. The simplest technique is to short the plate to cathode, screen grid to cathode, control grid to cathode, and screen grid to anode (individually, one at a time) using a vacuum relay through a section of #30 AWG copper wire. The wire will remain intact if the power supply protective circuitry is operating properly. An electronic crowbar will be required on the anode supply, and may be required on the other electrode supplies if the test outlined above is not passed. See EIMAC Application Bulletin #17 for further details.

Properly rated spark gaps must also be located between the screen grid and cathode and between the control grid and cathode to meet over-voltage protection criteria. A series resistance of 10 to 50 ohms is recommended in the screen and control grid power supply leads.

HIGH VOLTAGE — Normal operating voltages used with the X-2159 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

LOAD VSWR - The load VSWR should be monitored and the detected signal used to operate the interlock system to remove the plate voltage within 20 milliseconds after a fault occurs. In the case of high stored energy in the load system, care must be taken to avoid excessive return energy from damaging the tube and associated circuit components.

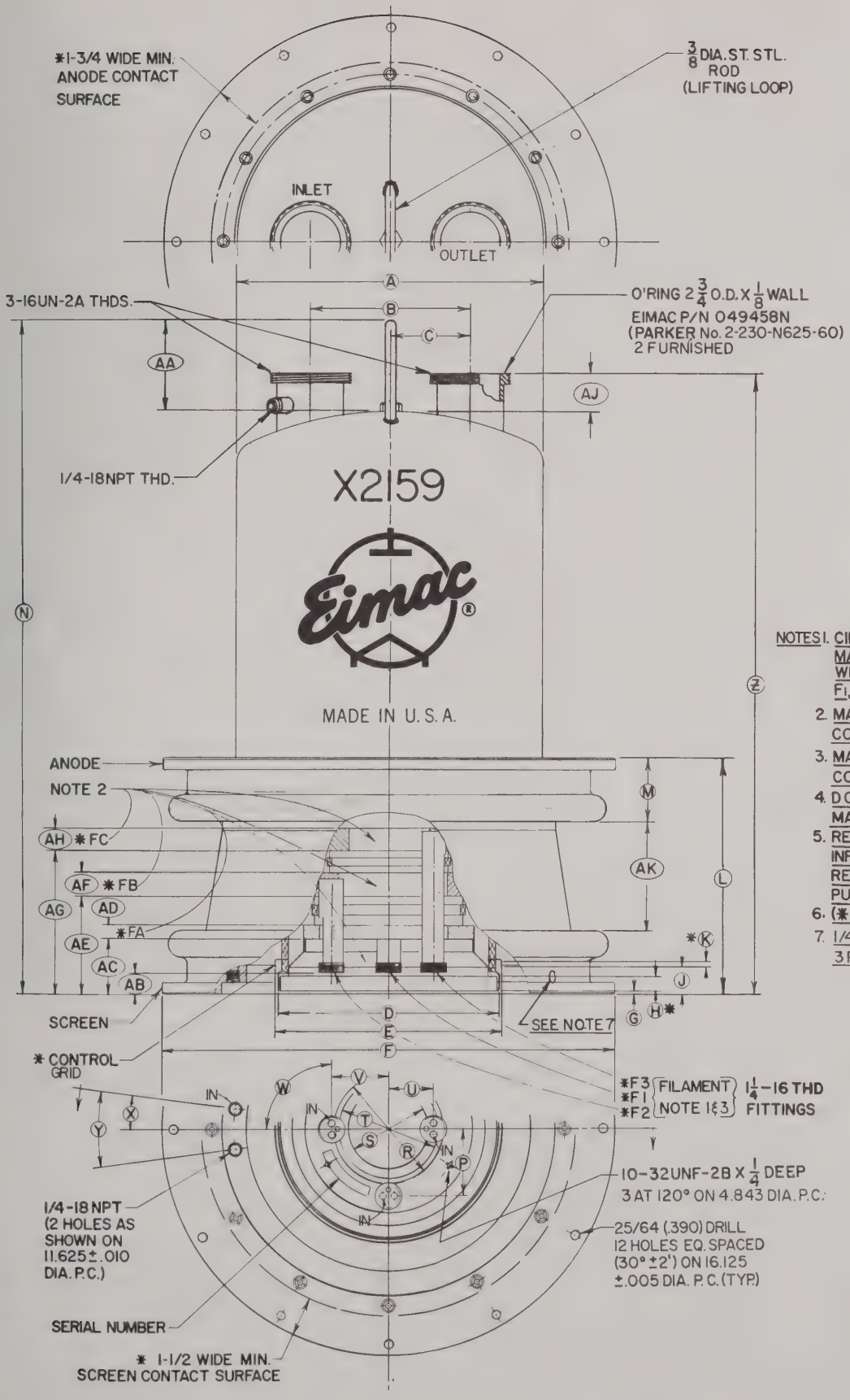
X-RADIATION — High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The X-2159, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirements for or the the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malufunction can result is serious X-ray exposure.

RADIO FREQUENCY RADIATION — Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

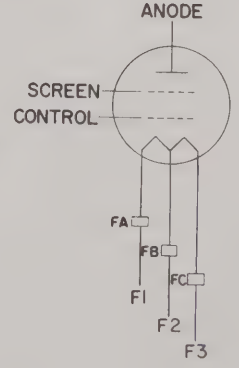
ELECTRODE RF TUNING CHARACTERISTICS - Typical electrode tuning characteristics may be obtained by contacting Application Engineering at EIMAC at the address listed below.

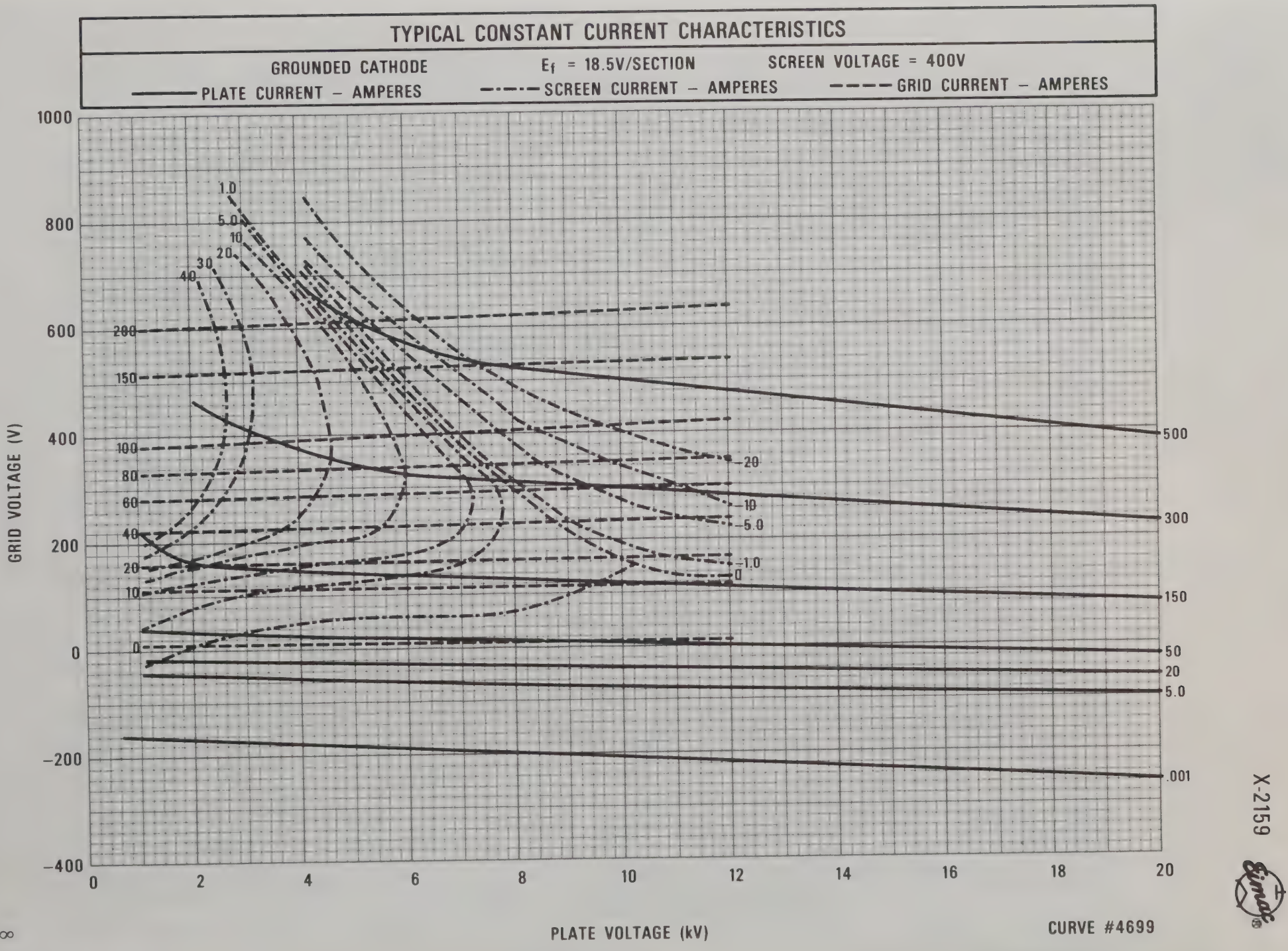
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to: Product Line Manager, High Power Tubes, Varian, EIMAC Divsion, 301 Industrial Way, San Carlos CA 94070.



DIM	INCHES			CENTIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.440	11560	- -	28.96	29.36	- -
B	- -	- -	6.000	- -	- -	15.24
C	- -	- -	3.000	- -	- -	7.62
D	8.235	8.265	- -	20.92	20.99	- -
E	8.485	8.525	- -	21.55	21.65	- -
F	16.970	17.030	- -	43.10	43.26	- -
G	- -	- -	0.025	- -	- -	0.063
H	0.310	- -	- -	0.79	- -	- -
J	0.900	1.000	- -	2.29	2.54	- -
K	0.180	- -	- -	0.46	- -	- -
L	8.700	8.900	- -	22.10	- -	- -
M	- -	- -	2.375	- -	- -	6.03
N	- -	- -	25.312	- -	- -	64.30
P	- -	- -	2.500	- -	- -	6.35
R	4.113	4.137	- -	10.45	10.51	- -
S	2.988	3.012	- -	7.59	7.65	- -
T	3.675	3.699	- -	9.33	9.40	- -
U	- -	- -	1.687	- -	- -	4.28
V	- -	- -	2.156	- -	- -	5.48
W	- -	- -	90°	- -	- -	90°
X	- -	- -	7-1/2°	- -	- -	7-1/2°
Y	- -	- -	15°	- -	- -	15°
Z	22.857	23.305	- -	58.06	59.19	- -
AA	- -	- -	3.575	- -	- -	9.08
AB	- -	- -	0.720	- -	- -	1.83
AC	1.950	2.100	- -	4.95	5.33	- -
AD	0.450	- -	- -	1.14	- -	- -
AE	3.560	3.680	- -	9.04	9.35	- -
AF	0.725	- -	- -	1.84	- -	- -
AG	5.300	5.450	- -	13.46	13.84	- -
AH	0.725	- -	- -	1.84	- -	- -
AJ	- -	- -	1.375	- -	- -	3.49
AK	- -	- -	4.093	- -	- -	10.40

NOTES:
1. CIRCUIT RETURNS MAY BE MADE TO FA, FB, OR FC WHICH ARE IN COMMON WITH F1, F2, AND F3, RESPECTIVELY.
2. MATE WITH EIMAC CONNECTOR SK-2315
3. MATE WITH EIMAC CONNECTOR SK-2310
4. DC RETURN SHOULD BE MADE TO F2 OR FB.
5. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
6. (*) CONTACT SURFACES
7. 1/4 DIA. WATER DRAIN HOLE - 3 PLACES.

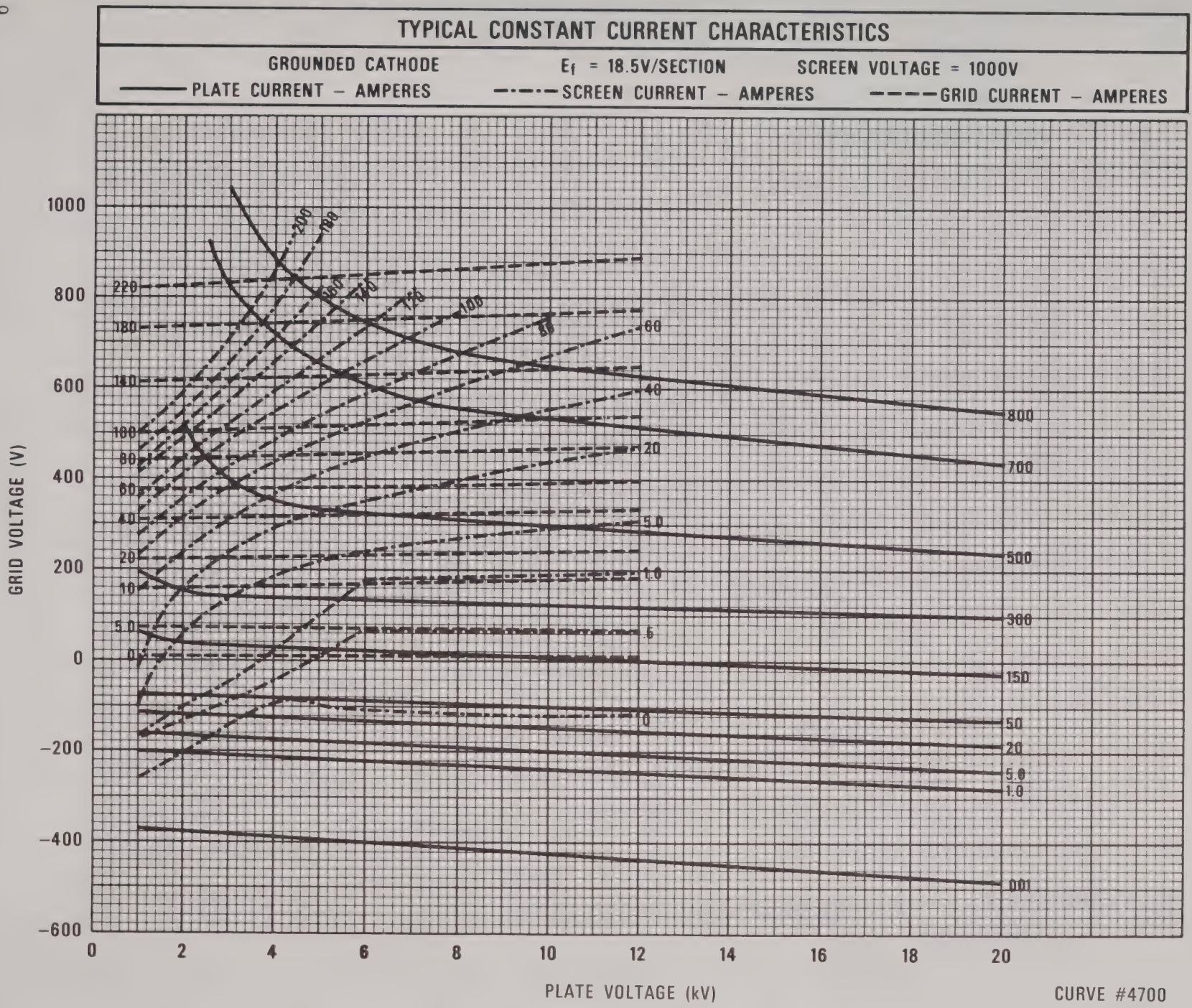




CURVE #4699

X-2159

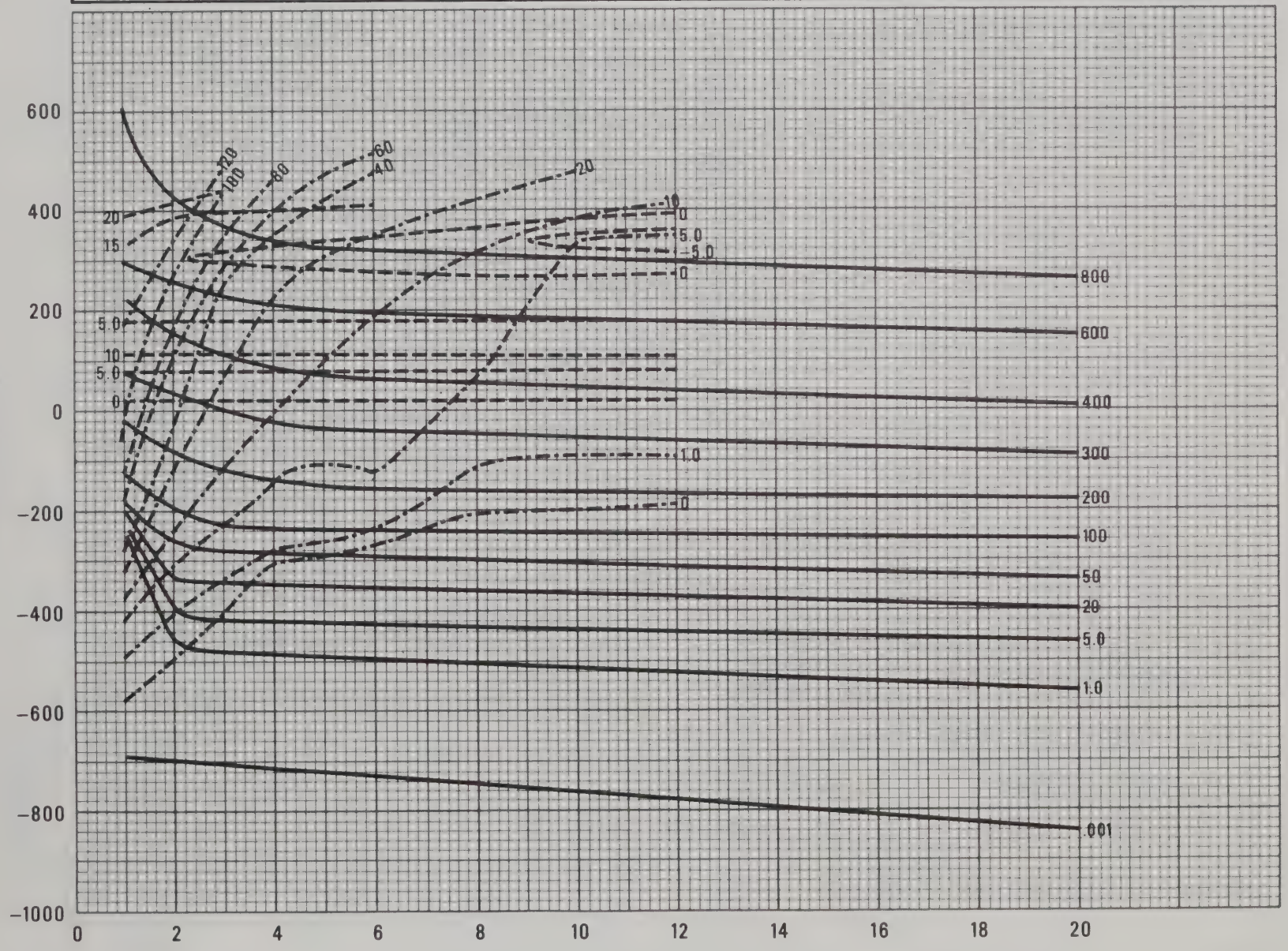
Eimac®


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
E_f = 18.5V/SECTION
SCREEN VOLTAGE = 1000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
1000
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
CURVE #4700

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED CATHODE — E_f = 18.5V/SECTION — SCREEN VOLTAGE = 2000V

PLATE CURRENT – AMPERES — SCREEN CURRENT – AMPERES — GRID CURRENT – AMPERES



CURVE #4701

TECHNICAL DATA

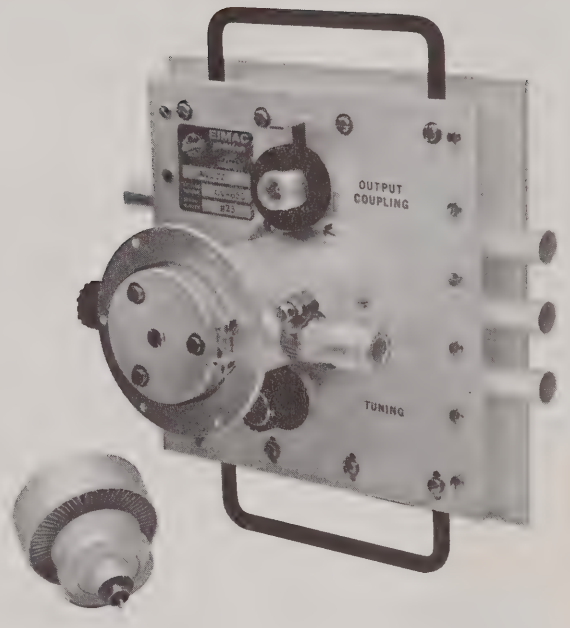
UHF CAVITY CV-850

FOR LAND MOBILE BASE STATION SERVICE

The EIMAC CV-850 is a power-amplifier cavity assembly designed for use in the 850-870 MHz portion of the band assigned for land mobile service, as the base station final amplifier.

Cavity design is straightforward and relatively simple. The amplifier tube is the EIMAC 8961/3CX400U7, a high-mu triode designed with beam-forming cathode and control grid geometry. It is cathode driven for a stage gain of approximately 13.5 dB. The triode design eliminates many of the cavity and equipment design complications associated with tetrode cavities but has comparable stage gain.

The CV-850 employs standard 50Ω coaxial rf connectors and silver-plated components for best performance and efficiency.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Tuning Range	850-870 MHz

MECHANICAL

Tube Type Used (not supplied with cavity)	EIMAC 8961/3CX400U7
Input & Output Connector	Type N
Cooling Required	Forced Air
Mounting	Optional; normally to 19 In. Panel
Overall Dimensions (nominal):	
Height (outside of handles for course tuning adjustment)	8.99 In; 22.80 cm
Width (outside of 1/2 In. air-inlet tubes)	7.62 In; 19.35 cm
Depth (tube not installed)	4.64 In; 11.78 cm
Net Weight, Approximate (tube not installed	7.5 lbs; 3.4 kg

1 Characteristics and operating values are based on performance tests. These figures may change without notice as a result of additional data or product refinement. EIMAC should be consulted before using this information for final equipment design.

(Effective 3-1-78) © by Varian

Printed in U.S.A.

TYPICAL OPERATION:

Heater Voltage (warmup or standby)	6.3	Vac
Heater Voltage (during operation - see HEATER VOLTAGE notes)	5.0	Vac
Heater Current (at 6.3 volts)	3.0	Aac
Anode Voltage	1500	Vdc
Grid Bias Voltage	-2.0	Vdc
Anode Current	400	mAdc
Grid Current [1]	-5.0	mAdc
Driving Power [1]	10	W
Useful Output Power [1]	225	W
Power Gain [1]	13.5	dB
Bandwidth (3 dB points)	6.5	MHz
Modulation	FM	

1 Approximate Value

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	3.0	3.6	A
Cathode Warmup Time, at 6.3 volts	60	---	Sec
Cavity Performance [1]			
Input reflected power	---	0.2	W
Input drive power	---	12.5	W
Useful power output, delivered to load	215	---	W

1 Electrical conditions as follows: Ef = 5.0 volts; Eb = 1500 Vdc; Ib = 400 mAdc. All voltages and currents read with meters calibrated to ± 2% (F.S.) accuracy or better; input drive power metering is 25 W full scale (for incident power) and 1.0 W full scale (for reflected power), calibrated to ± 5% (F.S.) accuracy or better; output power read with a power meter calibrated at frequency with an accuracy of ± 5% or better at the specified minimum power output value. Test performed at 850 MHz.

APPLICATION

MECHANICAL

TUBE INSTALLATION - The cavity is designed to accept and operate only with the EIMAC 8961/3CX400U7. This is a coaxial-base, external-anode, forced-air cooled high-mu triode, rated for 400 watts of anode dissipation, and designed specifically for UHF service. The tube should be inserted with care, making sure it is well aligned with the various contact collets before pressure is applied to force it into place. When the tube is removed for any reason it should be pulled straight out with a slow but steady pressure in order to avoid sudden release which may result in uneven tube movement and consequent damage to the contact collets. A special tube puller is available from EIMAC, as Part Number SK-603, which has been designed to remove the 3CX400U7 tube from the CV-850 smoothly and with no danger of collet damage. This device should be used for removing the tube only, and should not be used in inserting a tube in the cavity.

FORCED-AIR COOLING - For operation at full rated input power (Eb = 1500 Vdc and Ib = 400 mAdc), and assuming a normal full output power of 200 to 225 watts, the anode dissipation of the 3CX400U7 tube will approach 400 watts and a minimum of 11.5 cfm of clean filtered air must be passed through the cavity and the tube cooling fins to maintain tube temperatures well within ratings. Air flow past the tube must be in a base-to-anode direction. The pressure drop across the complete cavity with a tube installed, with a flow of 11.5 cfm will be approximately 0.55 Inch of Water. Air should enter the cavity assembly through the six half-inch sections of tubing, which act as a waveguide beyond cutoff, and exit through the tube anode cooling fins.

Protective interlocking should be provided so that if forced-air cooling fails for any reason, or falls below the minimum allowable, all voltages will be removed from the tube, including rf drive and the heater supply. Conversely, it should not be possible to apply any voltages to the tube, including its heater, unless an adequate supply of forced air is flowing through the cavity.

ELECTRICAL

CONNECTIONS - Heater voltage for the tube should be applied to the two lugs provided, each with a 6-32 screw. One of these terminals is also the cathode connection of the tube. (See outline drawing for identification of terminals).

For efficient operation at most power levels bias voltage is required. The most simple means of obtaining bias voltage is with a cathode resistor, which may be a fixed value (5 Ω for the TYPICAL OPERATION conditions shown on Page 1) or a wirewound variable if a simple power-output control is desirable or required for the particular installation.

For monitoring of operating conditions, and especially during tuning of the cavity, a grid current and plate current meter are suggested. For the grid current a ±25 mAdc zero-center meter is desirable. The plate current meter should be 500 mAdc full scale. Both meters should be in the B- lead, as shown in the simplified ELECTRICAL CIRCUIT DIAGRAM on the drawing of the 850 MHz Land Mobile Base Station Amplifier.

The tube anode is effectively bypassed internally in the cavity so no special precautions are required for application of B+ to the tube. Connection is most easily made to the center cap of the anode, and it is recommended that a 10 Ω, 10 W current-limiting resistor be used in the B+ line to protect the tube in case of an overload or fault condition.

The input and output rf connectors are both the standard Type "N".

HEATER VOLTAGE - The recommended nominal heater voltage of 6.3 volts should be applied for a minimum of 60 seconds before operation commences. After operation has started the heater voltage should be reduced to (approximately) 5.0 volts, to prevent cathode overheating due to rf transit-time effects in the tube. This reduction in heater voltage should preferably be made automatically with the application of rf drive voltage to the cavity. The optimum value for the reduced heater voltage is dependent on a number of factors, but predominantly the power level of operation, and where long life and consistent performance are factors operation at less than 5.0 volts on the heater may be desirable, though never below 4.0 volts for the CV-850 cavity. With stable operation achieved and all tuning completed with a heater voltage of 5.0 volts, the heater voltage may then be reduced in small steps until it is noted that some change in performance has occurred, such as a change in the power output. The operating value of heater voltage should then be raised and set to about 0.5 volts above the critical level found to affect performance.

For best life expectancy and most stable performance it is desirable to regulate the heater voltage and hold it to the final desired value within ± 2 percent.

INTERLOCKING & OVERLOADING PROTECTION - Application of anode voltage should be interlocked with the rf drive in a suitable manner so the drive voltage cannot be applied to the tube grid in the absence of anode voltage. As previously noted under FORCED-AIR COOLING, the equipment should include an air interlock so no voltages can be applied (including heater voltage) unless there is adequate flow of cooling air.

CONTROL GRID CHARACTERISTICS OF 3CX400U7 TUBE - The absolute maxium dissipation rating for the grid of the 3CX400U7 is 5 watts, though in normal operation in the CV-850 cavity this value is not approached. The use of a zero-center grid current meter, for tuning and monitoring, is recommended because the normal grid current indication can be negative, as shown under TYPICAL OPERATION. This negative current does not indicate any circuit or tube malfunction and is the result of tube characteristics and transit-time effects at the frequency of operation.

PRELIMINARY COARSE TUNING - Before any operation is attempted, unless the operator is assured the cavity has been pretuned to the desired frequency, the unit should be checked for its coarse tuning and then the fine tuning procedure outline below should be followed.

The end plates of the cavity, which have handles attached, may be moved to roughly set the frequency of operation. To move these end plates the retaining screws are loosened, the end plates are pushed or pulled to the desired position, and the screws are retightened. For operation near the low end of the cavity range (850 MHz), the plates should be pulled out and set between center and the end of the allowable travel. For operation near the high end of the range (870 MHz), the plates should be pushed in and set between the center and the farthest-in end of the travel.

Output coupling is adjusted by rotating the output Type N connector and should be set for maximum coupling by rotating the OUTPUT COUPLILNG control so the side flats of the output Type N connector are in a direction radial from the tube. These flats are parallel to the internal coupling loop. Note that the locking device must be loosened before the OUTPUT COUPLING control can be moved.

INITIAL OPERATION & FINE TUNING - Preliminary setup of the cavity should have included its mounting, arrangement for air cooling and air interlocking, installation of a known-good 3CX400U7 tube, the anode power supply and metering for the grid and anode current, the cathode bias source (which may be a fixed or variable wire-wound resistor, as shown in the ELECTRICAL CIRCUIT DIAGRAM of EIMAC Drwg. No. 169026, the heater voltage source (with provisions for reduction in voltage once rf operation of the cavity commences), and the rf driving source (interlocked to the anode voltage supply).

During tuning an rf input directional coupler should be connected in the input line. This can later be removed if continuous monitoring is not desired. A thruline wattmeter in the output line (capable of showing at least 250 watts full scale) will show if output power is normal when tuning is completed, and can then be removed if continuous monitoring is not desired.

If cathode resistive biasing is used, a value of 5Ω will result in -2.0 volts of tube bias with an anode current of 400 mAdc, and this value of bias is recommended during tuning and may also be used for operation at the full power input level with good efficiency. A variable resistor can be used to add resistance if a power output control is desired.

A 50Ω signal source should be coupled to the input coaxial connector (through a directional coupler), and a 50Ω load coupled to the output coaxial connector (through a thruline wattmeter). With cooling air on, fine tuning is then accomplished as follows:

1) Apply 6.3 volts heater voltage for 60 seconds minimum.

2) Apply anode voltage of 1500 Vdc maximum. The plate current meter should now read between 50 and 150 mAdc, and the grid current meter should be near zero.

3) Apply 5 to 10 watts of rf drive. The plate current should increase to between 300 and 400 mAdc and there should be an indication of output power on the output thruline wattmeter.

4) Adjust, the "TUNING" control for maximum power output. With the white dot pointing toward the "TUNING" label, rotate clockwise and notice the swing of power output. If the power output increases, goes through a maximum, and then decreases again before the white dot has gone through 90° of rotation, the course tuning (settling of the cavity end plates) is correct. If the power output increases steadily and only begins to fall after 90° of rotation, this indicates the cavity end plates are set too far out and must be moved toward the tube. Conversely, if the power output only decreases as the output tuning control is initially rotated clockwise the cavity end plates must be moved away from the tube.

5) If maximum power output is achieved in the first 90° as instructed, then all the screws which retain the moveable end plates may be final tightened.

6) The "OUTPUT COUPLING" control should now be adjusted for maximum power output. First the locking knob should be loosened so the coupling can be adjusted smoothly. The output coupling is turned to the point of maximum power output. The setting of the "TUNING" should then be rechecked, and both adjustments continued until maximum power output is achieved. The lock should then be reset on the OUTPUT COUPLING.

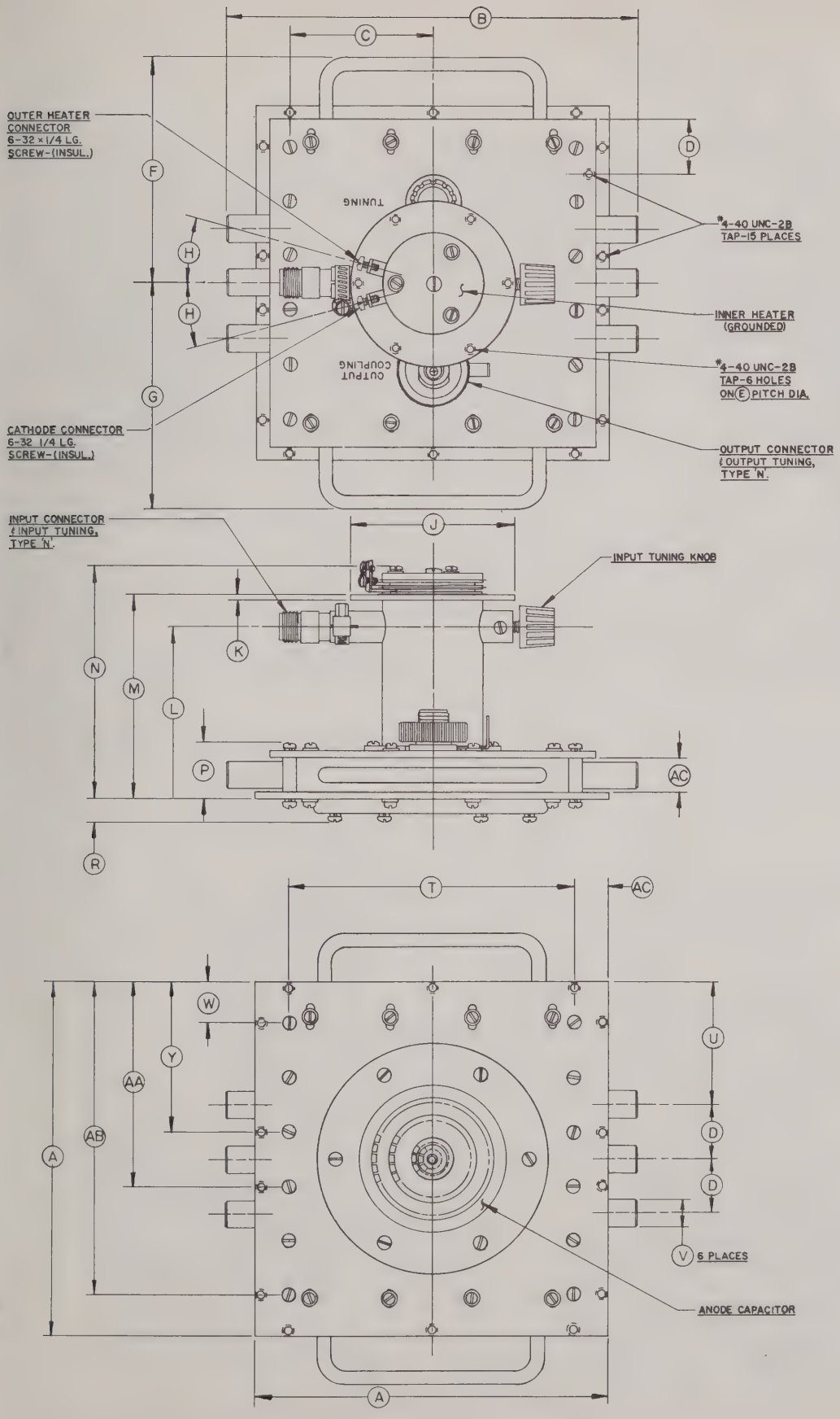
7) Reduce the heater voltage to 5.0 volts.

8) The input tuning and matching must then be accomplished, under full power conditions. The lock on the input coaxial-connector-probe, and the lock on the"INPUT TUNING KNOB" (see Outline Drawing) should both be loosened. The input coaxial-connector-probe is then moved in and out and the INPUT TUNING KNOB is adjusted for minimum reflected power. These two adjustments are interacting so they must be made alternately, adjusting for minimum reflected power. When this is achieved, both settings may be locked, and the TUNING control again checked, resetting as necessary for best power output.

9) With all tuning completed, driving power should be set to give an anode current of 400 mAdc.

HIGH VOLTAGE - Normal operating voltages used with the CV-850 cavity are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltage. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the the power supply and to discharge high-voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

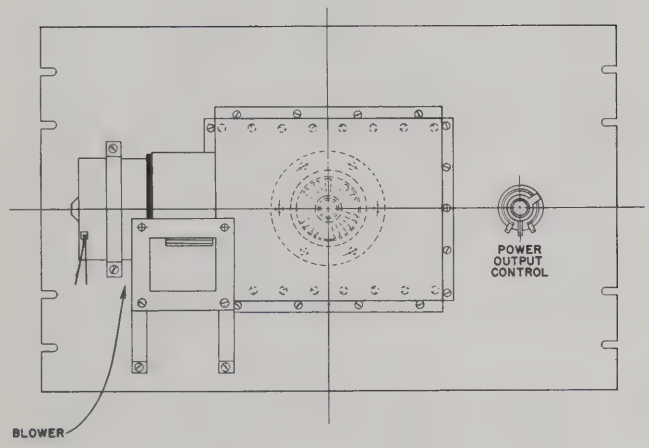
SPECIAL APPLICATIONS - If it is desired to operate the CV-850 cavity under conditions widely different from those given here, write to: Product Manager, Power Grid Tube Division, EIMAC Div. of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

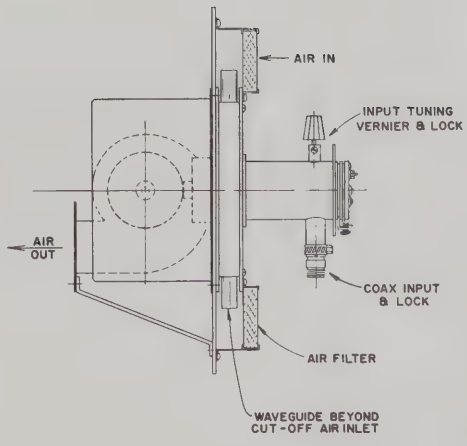


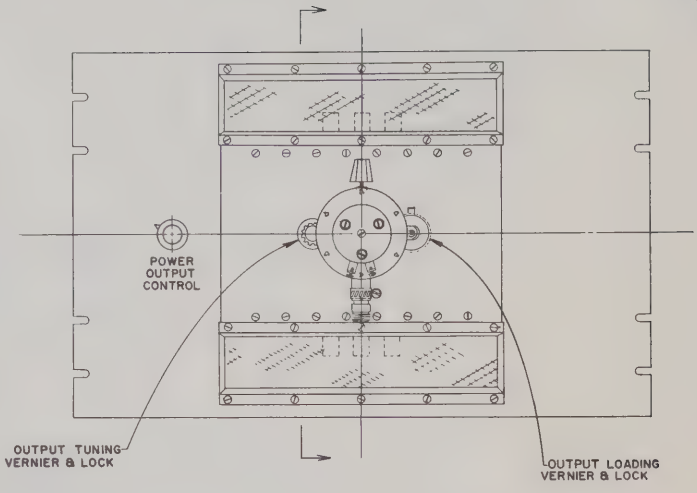
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF
A	6.470	6.530		164.34	165.87	
B			7.625			193.68
C	2.615	2.635		66.43	66.93	
D	.990	1.010		25.15	25.66	
E			2.750			69.85
F	4.307	4.619		109.40	117.32	
G	4.182	4.369		106.22	110.97	
H			15°			15°
J			3.000			76.20
K			.125			3.18
L			3.125			79.38
M			3.792			96.32
N			4.250			107.95
P			.875			22.23
R			.393			9.68
T	5.240	5.260		133.10	133.61	
U			2.250			57.15
V			.500			12.70
W	.740	.760		18.80	19.31	
Y	2.740	2.760		69.60	70.11	
AA	3.740	3.760		95.00	95.51	
AB	5.740	5.760		145.80	146.31	
AC			.625			15.88

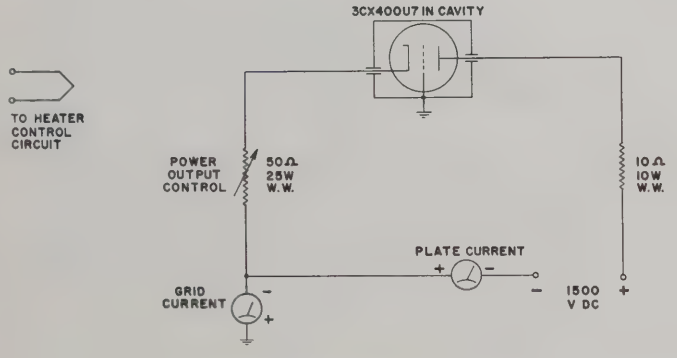
NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.









ELECTRICAL CIRCUIT DIAGRAM

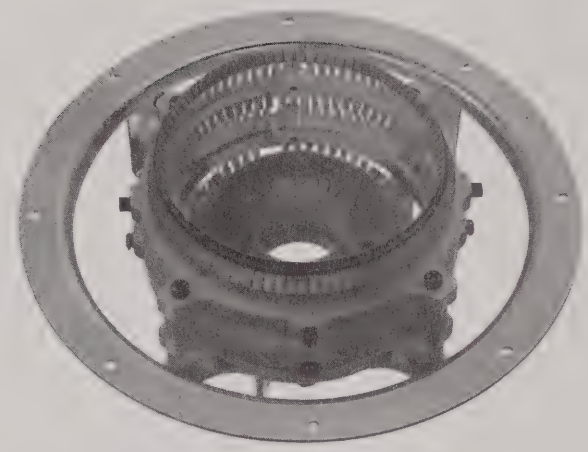
850 MHz Land Mobile
Base Station Power Amplifier

TECHNICAL DATA

SK-300A

AIR-SYSTEM SOCKET

The Eimac SK-300A Air-System Socket is recommended for use with those tube types listed at the bottom of the data sheet. The Eimac SK-306, SK-316 and SK-1306 Air Chimneys are available for use with this socket. When this socket is used, connection is made to each of the tube electrodes except the anode, by means of concentric rings of spring-finger contacts. The SK-300A is an improved version of the now obsolete SK-300, with significantly lower air horsepower requirements and reduced pressure drop at the air-flow rates used with these tube types. The SK-300A will replace an SK-300, as the mounting holes are identical.



BASE CONNECTION

The SK-300A Air-System Socket consists of four concentric rings of spring-finger contacts. The socket is provided with two filament connectors with a ¼" diameter hole in each connector for making connection to the inner and outer filament contacts. One 6-32 terminal is provided for DC connection to the screen-grid. RF connection to the screen-grid may be made directly to the collet. The SK-300A has four 8-32 terminals for connection to the control-grid. The four contact rings are shown on the outline drawing.

MAXIMUM WORKING VOLTAGE:

Screen-Grid	3000 Vdc
Control-Grid	3000 Vdc

MATERIALS AND FINISHES

The socket body is made from brass silver-plated. The contact material is a non-ferrous spring alloy, beryllium-copper, heat treated for spring action and silver-plated for good RF conductivity. The insulation material is teflon and ceramic.

INSTALLATION

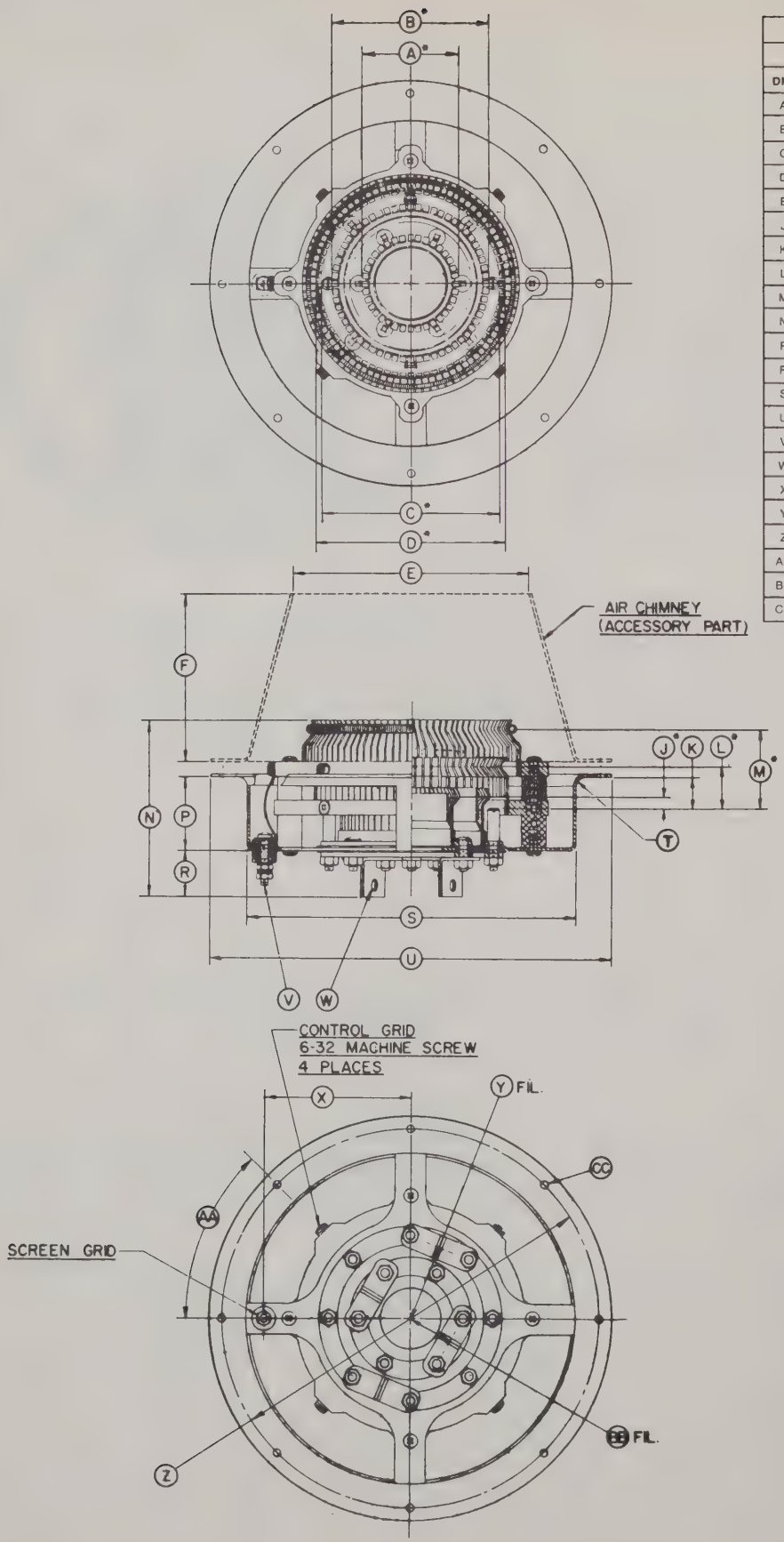
The SK-300A Air-System Socket can be mounted on a chassis deck, partition or pressurized compartment. Chassis mounting is accomplished by cutting a 7-3/16" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by eight 6-32 machine screws through the eight holes provided for fastening. The SK-300A is recommended for use with the following tubes, with the air chimney shown:

Tube Type	Recommended Chimney	Tube Type	Recommended Chimney
8170/4CX5000A	SK-306	8171/4CX10,000D	SK-1306
8170W/4CX5000R	SK-306	4CX10,000J	SK-1306
8909/4CX5000J	SK-306	8281/4CX15,000A	SK-316
8661/4CW10,000A	none req'd	8910/4CX15,000J	SK-316
4CW25,000A	none req'd		

NET WEIGHT - SK-300A socket ..... 3.25 lbs (1.48 kg)

(Effective 3-15-78) © 1964, 1969, 1978 by Varian

Printed in U.S.A.



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF	MIN	MAX	REF
A	2.001	2.061		50.82	52.35	
B	3.251	3.311		82.57	84.10	
C	3.672	3.732		93.27	94.79	
D	3.880	3.940		98.55	100.08	
E	4.890	4.921		124.21	124.99	
J	0.200	0.280		5.08	7.11	
K	0.600	0.695		15.24	17.65	
L	0.818	0.907		20.78	23.04	
M	1.559	1.699		39.60	43.15	
N	3.513	3.663		89.23	93.04	
P	1.444	1.530		36.68	38.86	
R	0.887	0.963		22.53	24.46	
S	6.720	6.785		170.69	172.34	
U	8.220	8.266		208.79	209.96	
V	6-32 NC-2A STUD					
W	0.235	0.265		5.97	6.73	
X	3.000	3.030		76.20	76.96	
Y			1.575			40.00
Z	7.730	7.770		196.34	197.36	
AA			45°			45°
BB			0.950			24.13
CC	0.140	0.154		3.56	3.91	

NOTES:
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. TOLERANCES ARE NOT CUMULATIVE.
3. (※)CONTACT SURFACES.

volume

1

general

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

Eimac Tube Type Numbering System

EIMAC tube types are identified by either a non-descriptive, sequentially-assigned 4-digit type number, standardized and registered with the ELECTRONIC INDUSTRIES ASSOCIATION (EIA) for non-duplication throughout the world, or by an EIMAC-originated coded numbering system, designed to convey descriptive information about the tube. Many tube types can be identified with either number, and are branded with both.

In general, the EIMAC type number consists of: a numeral indicating the number of electrodes, one or more letters denoting special characteristics, a numeral representing the plate dissipation rating, and a final letter to distinguish the tube from others which may bear similar or preceding letters and numerals. Triode types carry an additional number to indicate their approximate amplification factor.

To illustrate the system, a typical 1500-watt, ceramic, external-anode, forced-air cooled EIMAC triode is broken down as follows:

8877/3CX1500A7

EIA Type Number

Number of Electrodes
- 2 - Diode
- 3 - Triode
- 4 - Tetrode
- 5 - Pentode

Plate Dissipation (Watts)

Amplification Factor
- 1-0 to 10
- 2-11 to 20
- 3-21 to 30
- 4-31 to 50
- 5-51 to 100
- 6-101 to 200
- 7-201 to 500
- 8-501 to 1000

Description
- C - Ceramic Envelope (No Glass)
- L - External Anode, Liquid Convection Cooling
- N - External Anode, Natural Convection Air Cooling
- P - Primarily for Pulse Applications
- *R - Internal Anode, Radiation Cooled
- S - External Anode, Conduction Cooled
- V - External Anode, Vapor Cooled
- W - External Anode, Water Cooled
- X - External Anode, Forced-Air Cooled

* In older types, the dash, as in the case of the 4-250A, carries the meaning of "R" given above.

Version

Distinguishes tubes which, although alike as to number of electrodes and plate dissipation, are not necessarily interchangeable physically or electrically.

(Effective 6-1-73)

1950, 1967, 1973 Varian

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

7-1-73

(Effective 7-1-73) © 1973 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 7-1-73
Index 7-1-73
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 7-1-73
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 7-1-73
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 12-14-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 5-1-68
3-500Z 2-1-71
3-1000Z/8164 3-15-67
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 6-1-67
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 3-1-67
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX1000A7/8283 11-1-68
3CX1500A7/8877 5-15-71
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7480 11-1-68
8873/8874/8875 6-1-71
8874 . . . . . see 8873
8875 . . . . . see 8873
8933 12-14-72
8938 5-15-73

TETRODES

4-65A/8165 5-1-62
4-125A/4D21 6-1-67
4-250A/5D22 5-5-70
4-400A/8438 7-20-70
4-400C/6775 4-1-71
4-500A 3-10-72
4-1000A/8166 10-30-66
4CN15A 6-1-68
4CPX250K/8590 4-1-70
4CS250R 9-1-70
4CV8000A 3-15-71
4CV20,000A 6-1-68
4CV35,000A 5-15-68
4CV50,000E 5-1-70
4CV50,000J 7-15-71
4CV75,000A 6-15-71
4CV100,000C/8351 2-1-68
4CV250,000A 3-1-72
4CW800B/F 3-1-68
4CW2000A/8244 6-15-71
4CW10,000A/8661 4-15-63
4CW25,000A 2-1-72
4CW50,000E 7-1-70
4CW50,000J 7-15-71
4CW100,000D 7-1-67
4CW100,000E 9-1-70
4CW250,000A 3-1-71
4CX125C/F 6-1-67
4CX250B/7203 & 4CX250F/7204 5-15-73
4CX250K/8245 & 4CX250M/8246 5-1-68
4CX250R/7580W 6-16-61
4CX300A/8167 8-30-66
4CX300Y/8561 6-15-66
4CX350A/8321 & 4CX350F/8322 6-15-65
4CX350FJ/8904 9-1-71
4CX600B & 4CX600F 3-20-70
4CX600J/8809 & 4CX600JA/8921 8-15-71
4CX1000A/6168 5-1-70
4CX1000K/8352 8-20-66
4CX1500A 12-1-71
4CX1500B/8660 6-1-67
4CX3000A/8169 5-1-67
4CX5000A/8170 4-15-69
4CX5000J/8909 10-1-71
4CX5000R/8170W 4-15-71
4CX10,000D/8171 1-1-72
4CX10,000J 2-1-72
4CX15,000A/8281 5-15-71
4CX15,000J/8910 10-15-71
4CX35,000C/8349 12-1-70
4W300B/8249 5-1-70
4W20,000A/8173 4-15-64
4X150A/7034 & 4X150D/7035 5-4-70
4X150G/8172 6-15-66
4X500A 1-1-64
6816,6884,7843 11-15-71
6884 . . . . . see 6816
7843 . . . . . see 6816
8560A 7-15-71
8876 6-15-71

PENTODES

5-125B/4E27A 8-15-52
5-500A 5-1-68
5CX1500A 6-6-70
5CX3000A 8-1-67
264/8576 6-5-70
290 5-5-70
8295A 1-15-73

PULSE MODULATORS

4PR60C/8252W 6-30-71
4PR65A/8187 2-15-63
4PR125A/8247 3-15-64
4PR250C/8248 9-1-70
4PR400A/8188 9-15-65
4PR1000A/8189 12-15-65
6C21 12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6 4-4-70
Preformed Contact Finger Stock 6-15-71
HR Heat Dissipating Connectors 12-1-65
SK-300A 4-15-69
SK-306, SK-316 8-15-66
SK-400 4-1-56
SK-406, SK-416, SK-426 6-1-67
SK-410 11-15-62
SK-500 3-15-67
SK-506, SK-516 4-15-69
SK-510 6-15-71
SK-600A, SK-610A 6-15-71
SK-606, SK-626, SK-636B 8-15-66
SK-607 8-15-71

OTHER PRODUCTS

SK-620, SK-620A 3-15-67
SK-630, SK-630A 3-15-67
SK-640 2-15-66
SK-650, SK-655 1-15-66
SK-700, SK-710 10-15-66
SK-711A, SK-712A 3-15-71
SK-740 8-15-66
SK-760, SK-770 7-27-70
SK-800B, SK-806 4-9-64
SK-810B, SK-806 6-1-67
SK-860, SK-870 3-15-67
SK-890B, SK-806 6-1-67
SK-900, SK-906 8-15-66
SK-1300, SK-1310, SK-1320 3-1-72
SK-1306, SK-1406 8-15-66
SK-1400A, SK-1470A 10-15-66
SK-2200, SK-2210 8-15-72



DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

7-1-73

Printed in U.S.A.

100TH	T
100TL	T
152TH	T
152TL	T
1000T	T
1500T	T
250R	R
250TH	T
250TL	T
253	R
264/8576	PE
290	PE
2000T	T
2-01C	D
2-240A	R
2-450A	R
2-2000A	R
2C39A see 7289	PL
35T	T
35TG	T
304TH	T
304TL	T
3-200A3 see 592	T
3-400Z/8163	T
3-500Z	T
3-1000Z/8164	T
3C24	T
3CV1500A7	T
3CV30,000A3	T
3CV30,000H3	T
3CW5000A1/8240	T
3CW5000A3/8242	T
3CW5000F1/8241	T
3CW5000H3	T
3CW10,000H3	T
3CW20,000A1	T
3CW20,000A3	T
3CW20,000A7	T
3CW20,000H3	T
3CW25,000A3	T
3CW30,000H3	T
3CW40,000H3	T
3CX100A5 see 7289	PL
3CX1000A7/8283	T
3CX1500A7/8877	T
3CX2500A3/8161	T
3CX2500F3/8251	T
3CX2500H3	T
3CX3000A1/8238	T
3CX3000A7	T
3CX3000F1/8239	T
3CX3000F7/8162	T
3CX5000H3	T
3CX10,000A1/8158	T
3CX10,000A3/8159	T
3CX10,000A7/8160	T
3CX10,000H3	T
3CX15,000A3	T
3CX15,000A7	T
3CX15,000H3	T
3CX20,000A3	T
3CX20,000A7	T
3CX20,000H3	T
3W5000F3/8243	T
450TH	T
450TL	T
4-65A/8165	TET
4-125A/4D21	TET
4-250A/5D22	TET
4-400A/8438	TET
4-400C/6775	TET
4-500A	TET
4-1000A/8166	TET
4CN15A	TET
4CPX250K/8590	TET
4CS250R	TET
4CV800A	TET
4CV20,000A	TET
4CV35,000A	TET
4CV50,000E	TET
4CV50,000J	TET
4CV75,000A	TET
4CV100,000C/8351	TET
4CV250,000A	TET
4CW800B	TET
4CW800F see 4CW800B	TET
4CW2000A/8244	TET
4CW10,000A	TET
4CW25,000A	TET
4CW50,000E	TET
4CW50,000J	TET
4CW100,000D	TET
4CW100,000E	TET
4CW250,000A	TET
4CX125C	TET
4CX125F see 4CX125C	TET
4CX250B/7203	TET
4CX250F/7204	TET
4CX250K/8245	TET
4CX250M/8246	TET
4CX250R/7580W	TET
4CX300A/8167	TET
4CX300Y/8561	TET
4CX350A/8321	TET
4CX350F/8322	TET
4CX350FJ/8904	TET
4CX600B	TET
4CX600F see 4CX600B	TET
4CX600J/8809	TET
4CX600JA/8921 see 4CX600J	TET
4CX1000A/8168	TET
4CX1000K/8352	TET
4CX1500A	TET
4CX1500B/8660	TET
4CX3000A/8169	TET
4CX5000A/8170	TET
4CX5000J/8909	TET
4CX5000R/8170W	TET
4CX10,000D/8171	TET
4CX10,000J	TET
4CX15,000A/8281	TET
4CX15,000J/8910	TET
4CX35,000C/8349	TET
4D21 see 4-125A	TET
4E27A see 5-125B	PE
4PR60C/8252W	PM
4PR65A/8187	PM
4PR125A/8247	PM
4PR250C/8248	PM
4PR400A/8188	PM
4PR1000A/8189	PM
4W300B/8249	TET
4W20,000A/8173	TET
4X150A/7034	TET
4X150D/7035	TET
4X150G/8172	TET
4X500A	TET
575A	R
592/3-200A3	T
5867A	T
5-125B/4E27A	PE
5-500A	PE
5CX1500A	PE
5CX3000A	PE
5D22 see 4-250A	TET
673 see 575A	R
6696A	T
6697A	T
6775 see 4-400C	TET
6816	TET
6884 see 6816	TET
6894	R
6895 see 6894	R
6C21	PM
75TH	T
75TL	T
750TL	T
7034 see 4X150A	TET
7035 see 4X150A/D	TET
7203 see 4CX250B	TET
7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8933	PL
8938	T
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
CROSS-REFERENCE LIST

JULY 1, 1973

(Revised 7-1-73) © 1973 Varian Associates Printed in U.S.A.

EIMAC to JEDEC

EIMAC No.	JEDEC No.
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV1500A7	----
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CV50,000A7	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW25,000A3	----
3CW30,000H3	----
3CW30,000H7	----
3CW40,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000A7	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000A7	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	----
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CS250R	----
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV50,000J	----
4CV75,000A	----
4CV100,000C	8351
4CV250,000A	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	----
4CW50,000E	----
4CW50,000J	----
4CW100,000D	----
4CW100,000E	----
4CW250,000A	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	----
4CX600F	----
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	----
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	----
177A	----
177WA	6549W
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC No.	JEDEC No.
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8295A	8295A
8403	8403
8432	8432
8533W	8533W
8560A	8560A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8892	8892
8893	8893
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8911	8911
8912	8912
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944

JEDEC to EIMAC

JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549W	177WA
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	4-400C
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533	8533
8560A	8560A
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912
8921	4CX600JA
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944


Eimac

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

POWER GRID TUBE SELECTION GUIDE

(Effective 7-1-73) © by Varian

Printed in U.S.A.

POWER GRID TUBE SELECTION GUIDE

The EIMAC Power Grid Tube Selection Guide is arranged for ease in making type selections by use rather than tube type. The Guide is applications oriented. It includes a switch tube capability curve.

Tube types are listed according to the principle modes of service for which they are rated. Under each mode of service, EIMAC tube types suitable for the application are tabulated in descending order of the most significant tube parameter in the left hand column. For example, in the POWER AMPLIFIER tabulation, tube types are listed in descending order of typical rf power output; PULSE REGULATOR tubes are listed in descending order of peak current capability. This format places emphasis on tube application and facilitates comparison in terms of the significant ratings of the EIMAC types available for a given application.

After preliminary selection of a tube type (or types) from the Guide, the final choice should be based upon the complete ratings from the EIMAC data sheet for the tube in question.

POWER GRID TUBE SELECTION GUIDE

TABLE OF CONTENTS

SECTION	PAGE
RF POWER AMPLIFIER - LINEAR	1, 2
RF POWER AMPLIFIER - CLASS C, CW or FM	3, 4, 5
RF POWER AMPLIFIER (PLANAR TRIODE TYPES) - CLASS C, CW or FM	6
RF POWER AMPLIFIER - PLATE MODULATED	7, 8, 9
RF POWER AMPLIFIER - GRID PULSED	10, 11
RF POWER AMPLIFIER (PLANAR TRIODE TYPES) - GRID OR PLATE PULSED	12, 13
AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR	14, 15
OSCILLATOR OR AMPLIFIER, CLASS C, INDUSTRIAL	16
VOLTAGE OR CURRENT DC REGULATOR	17
SWITCH TUBE OR PULSED REGULATOR SERVICE	18, 19, 20
POWER/CURRENT/VOLTAGE CHART FOR SWITCH TUBE OR PULSED REGULATOR SERVICE	21, 22

RADIO FREQUENCY POWER AMPLIFIER

LINEAR

Peak Env. Power ‡ (kW) Typical	Rated Anode Diss. (kW)	Freq. (MHz) F1 / upper useful	Inter-Mod. Distortion (dB) Typical † 3rd	5th	Cooling	EIMAC Quick Ref. Catalog * Page No.	EIMAC Type Number	Type of Tube	Application Note
1180	1250	30 / 50			water	--	X2159	Tetrode	
600	650	50 / 100			Water	--	X2170	Tetrode	
230	250	30 / 50	-31	-43	vapor	38	4CV250,000A	Tetrode	
230	250	30 / 50	-31	-43	water	36	4CW250,000A	Tetrode	
168	100	108 / 150			water	35	4CW100,000E	Tetrode	
123	100	30 / 50	-26	-40	vapor	38	4CV100,000C	Tetrode	
105	50	110 / 220			vapor	4	3CV50,000A7	Triode	Grounded grid
55	35	30 / 50	-30	-40	air	33	4CX35,000C	Tetrode	
45	50	110 / 200	-46	-60	vapor	6	4CV50,000J	Tetrode	
45	50	110 / 200	-46	-60	water	6	4CW50,000J	Tetrode	
17	10	140 / 220	-40	-39	air	16	3CX10,000A7	Triode	Grounded grid
17	20	140 / 220	-40	-39	water	20	3CW20,000A7	Triode	Grounded grid
17	15	110 / 220	-40	-39	air	4	3CX15,000A7	Triode	Grounded grid
14	10	100 / 220	-30	-36	air	33	4CX10,000D	Tetrode	
12	15	110 / 220	-41	-41	air	33	4CX15,000J	Tetrode	
10.5	10	100 / 220	-35	-40	air	5	4CX10,000J	Tetrode	
10	5	100 / 220	-30	-38	air	32	4CX5000A	Tetrode	
10	5	100 / 220	-30	-38	air	32	4CX5000R	Tetrode	
5.8	3	150 / 220	-40	-43	air	41	5CX3000A	Pentode	
5.8	3	30 / --	-26	-41	air	41	264/8576	Pentode	
5.5	3	110 / ---	-51	-45	air	15	3CX3000A7	Triode	Grounded grid
5.3	3	150 / 220	-32	-36	air	32	4CX3000A	Tetrode	
5.3	5	30 / --	-26	-40	air	41	290	Pentode	
3.3	5	100 / 220	-41	-44	air	32	4CX5000J	Tetrode	
2.06	1	220 / 400	-31	-39	air	13	3CX1000A7	Triode	Grounded grid

‡ Plate power output, calculated or measured at Low Frequency.

* Catalog No.171

† Calculated or measured by two-tone method at 2.0 MHz

RADIO FREQUENCY POWER AMPLIFIER

LINEAR

Peak Env. Power ‡ (Watts) Typical	Rated Anode Diss. (Watts)	Freq. (MHz) F1 / upper useful	Inter-Mod. Distortion (dB) Typical † 3rd	5th	Cooling	EIMAC Quick Ref. Catalog * Page No.	EIMAC Type Number	Type of Tube	Application Note
2050	1500	220 / 400	-38	-41	air	3	3CX1500A7	Triode	Grounded grid
2030	1500	500 / ---	-44	-44	air	--	8938	Triode	Grounded grid
1785	1500	110 / 220	-33	-42	air	40	5CX1500A	Pentode	
1160	1000	110 / 220	-43	-47	air	31	4CX1500B	Tetrode	
1080	1000	110 / ---	-29	-37	air	13	3-1000Z	Triode	Grounded grid
940	500	110 / ---	-40	-45	air	13	3-500Z	Triode	Grounded grid
645	500	110 / ---	-33	-41	air	39	5-500A	Pentode	
620	200	500 / 900	-35	-36	conduction	3	8873	Triode	Grounded grid
620	400	500 / 900	-35	-36	air	3	8874	Triode	Grounded grid
620	300	500 / 900	-35	-36	air	3	8875	Triode	Grounded grid
590	400	110 / ---	-28	-35	air	12	3-400Z	Triode	Grounded grid
580	600	30 / ---	-43	-43	air	30	4CX600J	Tetrode	
495	400	110 / ---			air	24	4-400C	Tetrode	
295	250	500 / ---	-25	-30	air	28	4CX250R	Tetrode	
295	250	500 / ---	-25	-30	conduction	5	4CS250R	Tetrode	
263	350	30 / 220	-30	-35	air	30	4CX350A	Tetrode	
263	350	30 / 220	-30	-35	air	30	4CX350F	Tetrode	
263	350	30 / 220	-40	-45	air	5	4CX350FJ	Tetrode	
226	200	500 / ---			conduction	25	8560A	Tetrode	

‡ Plate power output. * Catalog No. 171 † Calculated or measured by two-tone meathod at 2.0 MHz

RF POWER AMPLIFIER

CLASS C, CW OR FM

Plate Pwr. Output (kW) Typical *	Plate Dissipation (Rated kW)	Freq. (MHz) † F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page. No. ‡	EIMAC Type Number	Type of Tube	
1650	1250	30 / 50	x200	Water	--	X-2159	Tetrode	
1050	650	50 / 100	x300	Water	--	X-2170	Tetrode	
460	250	30 / 50	x150	Vapor	38	4CV250,000A	Tetrode	
460	250	30 / 50	x150	Water	36	4CW250,000A	Tetrode	
220	100	108 / 150	x1800	Water	35	4CW100,000E	Tetrode	
168	100	30 / 50	x1350	Vapor	38	4CV100,000C	Tetrode	
165	100	30 / 50	x140	Water	35	4CW100,000D	Tetrode	
139	75	30 / 50	x1150	Vapor	38	4CV75,000A	Tetrode	
137	50	110 / 220	x900	Vapor	37	4CV50,000E	Tetrode	
137	50	110 / 220	x900	Water	35	4CW50,000E	Tetrode	
110	35	30 / 50	x425	Air	33	4CX35,000C	Tetrode	
80	60	40 / 80	x130	Water	21	6696A	Triode	
80	80	40 / 80	x130	Vapor	22	7480	Triode	
80	35	40 / 80	x130	Air	18	6697A	Triode	
64	20	90 / 150	x66	Air	17	3CX20,000A3	Triode	
64	20	90 / 150	x66	Air	17	3CX20,000H3	Triode	
42	25	100 / 150	x37	Water	21	3CW25,000A3	Triode	
36.5	15	110 / 225	x166	Air	33	4CX15,000A	Tetrode	
30	15	100 / 150	x45	Air	17	3CX15,000A3	Triode	
24.5	10	140 / 200	x6	Air	16	3CX10,000A3	Triode	Gnd.Grid connection
24.5	20	140 / 200	x6	Water	20	3CW20,000A3	Triode	Gnd.Grid connection
21.3	15	110 / 160	x50	Air	4	3CX15,000A7	Triode	
16	5	100 / 220	x1050	Air	32	4CX5000A	Tetrode	

* Power Output and Power Gain are calculated or measured at Low Frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

‡ Catalog #171.

RF POWER AMPLIFIER

CLASS C, CW OR FM

Plate Pwr. Output (W) Typical *	Plate Dissipation (Rated W)	Freq. (MHz) † F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type Number	Type of Tube	
16,000	5000	100 / 220	x1050	Air	32	4CX5000R	Tetrode	
16,000	10,000	100 / 220	x1050	Air	33	4CX10,000D	Tetrode	
16,000	10,000	100 / 220	x1050	Water	34	4CW10,000A	Tetrode	
11,000	3000	150 / 220	x260	Air	32	4CX3000A	Tetrode	
10,000	4000	75 / 150	x73	Air	13	3CX2500A3	Triode	
10,000	4000	75 / 150	x73	Air	14	3CX2500F3	Triode	
10,000	5000	75 / 150	x73	Water	18	3CW5000A3	Triode	
10,000	5000	75 / 150	x73	Water	19	3CW5000F3	Triode	
8500	3000	150 / 220	x160	Air	41	5CX3000A	Pentode	
3400	1000	110 / ---	x225	Air	25	4-1000A	Tetrode	
3200	1500	110 / 220	x350	Air	31	4CX1500A	Tetrode	
3180	1500	110 / 220	x350	Air	40	5CX1500A	Pentode	
2600 §	1500	250 / ---	x33	Air	3	3CX1500A7	Triode	Gnd.grid
1500 §§	1500	500 / ---	x30	Air	---	8938	Triode	Gnd.grid
1265	500	110 / ---	x140	Air	5	4-500A	Pentode	
1100	400	110 / ---	x190	Air	24	4-400C	Tetrode	
1000	250	110 / ---	x190	Air	23	4-250A	Tetrode	
840	350	100 / 150	x31	Air	12	5867A	Triode	
805	250	60 / ---	x9	Air	12	6569	Triode	Gnd.grid
805	500	110 / ---	x67	Air	5	4-500A	Tetrode	
745	400	60 / ---	x8	Air	12	6580	Triode	Gnd.grid
600	300	110 / 220	x158	Air	29	4CX300Y	Tetrode	
500	300	500 / ---	x177	Air	29	4CX300A	Tetrode	
380	250	500 / ---	x190	Conduction	5	4CS250R	Tetrode	
380	250	500 / ---	x130	Air	27	4CX250B	Tetrode	
380	250	500 / ---	x130	Air	27	4CX250F	Tetrode	

§ Pwr.output shown is measured useful, delivered to load, at 104 MHz.

§§ Useful power output, measured at 430 MHz

RF POWER AMPLIFIER

CLASS C, CW OR FM

Plate Pwr. Output (W) Typical *	Plate Dissipation (Rated W)	Freq.(MHz) † F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type Number	Type of Tube
380	250	500 / 1500	x130	Air	28	4CX250K	Tetrode
380	250	500 / 1500	x130	Air	28	4CX250M	Tetrode
380	250	500 / ---	x190	Air	28	4CX250R	Tetrode
380	250	150 / 500	x130	Air	27	4X150A	Tetrode
380	250	150 / 500	x130	Air	27	4X150D	Tetrode
380	250	150 / 500	x130	Air	28	7609	Tetrode
380	250	500 / ---	x130	Conduction	25	8560A	Tetrode
375	125	120 / ---	x150	Air	23	4-125A	Tetrode
320	200 400 300	500 / ---	x35	Conduction Air Air	3	8873 8874 8875	Triode
270	65	150 / ---	x160	Convection	23	4-65A	Tetrode
100	115	1215 / ---	x27 @ 400 MHz	Air	26	6816	Tetrode
100	115	1215 / ---	x27 @ 400 MHz	Air	26	6884	Tetrode
100	115	1215 / ---	x27 @ 400 MHz	Air	27	7457	Tetrode
100	115	1215 / ---	x27 @ 400 MHz	Conduction	25	7843	Tetrode

PLANAR TRIODE TYPES

FOR RF POWER AMPLIFIER SERVICE

CLASS C, CW OR FM

Useful Pwr. Output (W) Typical † @ 1.0 GHz	Useful Pwr. Output (W) Typical † @ 2.5 GHz	Anode Diss. (W)	Cooling	Nom. Amp. Factor	Nom. Trans-Conductance (mmhos)	Fl Freq. (GHz)	Upper Useful Freq. (GHz)	Catalog Page No.	EIMAC Type Number
580	220	750	C&C & FA	65	100	2.5	3.0		8940
295	110	150 *	C&C or FA	75	40	2.5	3.0		Y-519
250	90	150	C&C or FA	75	30	2.5	3.0		8757
250	90	150	C&C or FA	75	30	2.5	3.0		8847
140	50	100	C&C & FA	80	30	2.5	3.0		7211
140	50	100	C&C & FA	80	30	2.5	3.0		8403
100	35	100	C&C & FA	80	25	2.5	3.0		7855
100	35	150	C&C & FA	100	25	2.5	3.0		8756
90	19	100	C&C & FA	100	25	2.5	3.0		7815R
90	19	100	C&C & FA	100	25	2.5	3.0		8745
80	38	100	C&C or FA	60	30	2.5	3.5		8893
40	25	50	C&C or FA	60	30	3.5	5.0		8892
40	17	100	C&C & FA	100	25	2.5	3.0		7289

† Useful power is that delivered to the load. Figures may vary depending on circuit efficiency and individual tube characteristics. The complete ratings and characteristics of the tube type should be considered by the circuit designer.

* Higher anode dissipation is permissible with special radiator.

RF POWER AMPLIFIER

CLASS C

PLATE MODULATED

Carrier Pwr. Output (kW) TYPICAL *	Plate Diss. at TYPICAL conditions (kW)	Freq. (MHz)† F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type. No.	Type of Tube
1375	800	30 / 50	x200	Water	--	X-2159	Tetrode
700	160	50 / 100	x290	Water	--	X-2170	Tetrode
285	119	30 / 50	x120	Vapor	38	4CV250,000A	Tetrode
285	119	30 / 50	x120	Water	36	4CW250,000A	Tetrode
140	47	30 / 50	x110	Vapor	38	4CV100,000C	Tetrode
140	35	108 / 150	x260	Water	35	4CW100,000E	Tetrode
138	22	30 / 50	x160	Water	35	4CW100,000D	Tetrode
110	22	110 / 220	x160	Water	35	4CW50,000E	Tetrode
110	22	110 / 220	x160	Vapor	37	4CV50,000E	Tetrode
60	20	40 / 80	x30	Water	21	6696A	Triode
60	20	40 / 80	x30	Air	18	6697A	Triode
60	20	40 / 80	x30	Vapor	22	7480	Triode
55	13	30 / 50	x440	Air	33	4CX35,000C	Tetrode
55	11	30 / 50	x220	Vapor	38	4CV75,000A	Tetrode
27.5	7.5	90 / 150	x18	Air	17	3CX20,000A3	Triode
27.5	7.5	90 / 150	x18	Air	17	3CX20,000H3	Triode
23.5	5.8	110 / 225	x155	Air	33	4CX15,000A	Tetrode
23.5	5.8	110 / 225	x155	Vapor	37	4CV35,000A	Tetrode
18	5.4	100 / 150	x37	Air	17	3CX15,000A3	Triode
12.4	2.6	140 / 200	x24	Air	16	3CX10,000A3	Triode

* Power Output and Power Gain are calculated or measured at Low Frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

‡ Catalog #171.

RF POWER AMPLIFIER

CLASS C

PLATE MODULATED

Carrier Pwr. Output (W) TYPICAL *	Plate Diss. at TYPICAL conditions (W)	Freq. (MHz)† F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type No.	Type of Tube
8500	3500	100 / 220	x230	Air	32	4CX5000A	Tetrode
8500	3500	100 / 220	x230	Air	33	4CX10,000D	Tetrode
8500	3500	100 / 220	x230	Air	32	4CX5000R	Tetrode
7750	3250	30 / ---	x100	Vapor	37	4CV20,000A	Tetrode
5750	1250	150 / 220	x190	Air	32	4CX3000A	Tetrode
5750	1250	150 / ---	x190	Vapor	37	4CV8000A	Tetrode
5300	950	75 / 150	x45	Air	13	3CX2500A3	Triode
5300	950	75 / 150	x45	Air	14	3CX2500F3	Triode
2630	670	110 / ---	x290	Air	25	4-1000A	Tetrode
2320	780	110 / 220	x230	Air	31	4CX1500A	Tetrode
1960	575	110 / 220	x195	Air	40	5CX1500A	Pentode
1765	485	110 / ---	x50	Air	13	3-1000Z	Triode
830	245	110 / ---	x140	Air	5	4-500A	Tetrode
785	280	110 / ---	x110	Air	39	5-500A	Pentode
640	185	110 / ---	x25	Air	13	3-500Z	Triode
630	195	110 / ---	x190	Air	24	4-400C	Tetrode
510	165	110 / ---	x160	Air	23	4-250A	Tetrode
300	80	120 / ---	x90	Air	23	4-125A	Tetrode
300	200	110 / 220	x175	Air	29	4CX300Y	Tetrode
235	65	500 / ---	x160	Conduction	5	4CS250R	Tetrode
235	65	500 / ---	x135	Air	27	4CX250B	Tetrode
235	65	500 / ---	x135	Air	27	4CX250F	Tetrode
235	65	500 / 1500	x135	Air	28	4CX250K	Tetrode
235	65	500 / 1500	x135	Air	28	4CX250M	Tetrode

RF POWER AMPLIFIER

CLASS C

PLATE MODULATED

Carrier Pwr. Output (W) TYPICAL *	Plate Diss. at TYPICAL conditions (W)	Freq. (MHz)† F1 / upper useful	Power Gain *	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type No.	Type of Tube
235	65	500 / ---	x160	Air	28	4CX250R	Tetrode
235	65	500 / ---	x135	Air	29	4CX300A	Tetrode
235	65	150 / 500	x135	Air	27	4X150A	Tetrode
235	65	150 / 500	x135	Air	27	4X150D	Tetrode
235	65	500 / ---	x135	Conduction	25	8560A	Tetrode
210	45	150 / ---	x65	Convection	23	4-65A	Tetrode
45	45	1215 / ---	x15 @ 400 MHz	Air	26	6884	Tetrode
45	45	1215 / ---	x15 @ 400 MHz	Air	27	7457	Tetrode
45	45	1215 / ---	x15 @ 400 MHz	Conduction	25	7843	Tetrode

RF POWER AMPLIFIER

GRID PULSED *

Peak RF Pwr. Output (kw) β TYPICAL	Anode Dissipation (Rated kW)	Freq. (MHz) † F1 / upper useful	Maximum Anode Voltage (kVdc)	Maximum Anode Current (a) β	Cooling	EIMAC Quick Ref. Catalog Page No.‡	EIMAC Pulse Eng. Newsletter Page No.§	EIMAC Type Number	Type of Tube
3900	1250	30 / 50	30	195	Water	--	--	X-2159	Tetrode
2000	650	50 / 100	30	100	Water	--	--	X-2170	Tetrode
1000	100	108 / 150	30	50	Water	35	9-10	4CW100,000E	Tetrode
500	50	110 / 220	30	33	Vapor	37	9-10	4CV50,000E	Tetrode
500	50	110 / 220	30	33	Water	35	9-10	4CW50,000E	Tetrode
160	15	110 / 225	12	20	Air	33	11-12	4CX15,000A	Tetrode
80	10	100 / 220	10	13	Air	33	11-12	4CX10,000D	Tetrode
80	10	100 / 220	10	13	Air	32	11-12	4CX5000A	Tetrode
80	10	100 / 220	10	13	Air	32	11-12	4CX5000R	Tetrode
35	3.0	--- / 500	9.0	10	Air	---	---	Y-669	Triode
34	1.0	110 / ---	15	3.5	Air	43	11-12	4PR1000A	Tetrode
34	1.0	110 / ---	15	3.5	Air	43	11-12	4PR1000B	Tetrode
PSP 28	0.25	500 / 1500	eb=7.0 ec2=1.5	6.0	Air	29	9-10	4CPX250K	Tetrode
PSP 28	0.25	500 / 1500	eb=7.0 ec2=1.5	6.0	Air	28	9-10	4CX250K	Tetrode
PSP 28	0.25	500 / 1500	eb=7.0 ec2=1.5	6.0	Air	28	9-10	4CX250M	Tetrode
11	0.40	110 / ---	10	1.7	Air	43	11-12	4PR400A	Tetrode
10	0.25	500 / 1500	5.5	0.8	Air	29	9-10	4CPX250K	Tetrode (Cath.driven, screen pulsed)
1.6	0.20	500 / ---	3.0	0.8	Conduction	3	---	8873	Triode
1.6	0.40	500 / ---	3.0	0.8	Air	3	---	8874	Triode
1.6	0.30	500 / ---	3.0	0.8	Air	3	---	8875	Triode
1.6	0.25	500 / ---	3.0	0.8	Air	27	9-10	4CX250B & F	Tetrodes
1.6	0.25	500 / 1500	3.0	0.8	Air	2	9-10	4CX250K & M	Tetrodes

* Grid Pulsed service unless otherwise indicated.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced anode power input.

‡ Catalog #171.

§ EIMAC Engineering Newsletter SUMMARY OF EIMAC TUBES FOR PULSE OR SWITCH SERVICE available on request.

β Average during the pulse. Power Output data is anode power (does not include circuit losses), calculated or measured at Low Frequency.

PSP Anode and screen-grid pulsed, as indicated.

RF POWER AMPLIFIER

GRID PULSED *

Peak RF Pwr. Output (kw) β TYPICAL	Anode Dissipation (Rated kW)	Freq. (MHz) † F1 / upper useful	Maximum Anode Voltage (kVdc)	Maximum Anode Current (a) β	Cooling	EIMAC Quick Ref. Catalog Page No.‡	EIMAC Pulse Eng. Newsletter Page No.§	EIMAC Type Number	Type of Tube
4.0	0.125	120 / ---	9.0	0.7	Air	23	11-12	4PR125A	Tetrode
2.6	0.300	110 / 220	3.0	1.3	Air	29	11-12	4CX300Y	Tetrode
2.0	0.065	150 / ---	7.5	0.4	Convection	23	11-12	4PR65A	Tetrode

PLANAR TRIODE TYPES

FOR GRID OR PLATE PULSED RF POWER AMPLIFIER SERVICE

OPERATIONAL DATA					RATING/DESIGN DATA						
Useful RF* Pwr Out (W) @ 1.0 GHz	Useful RF* Pwr Out (W) @ 3.0 GHz	Pulsed Element	Pulse Width (μs)†	Duty†	EIMAC TYPE NUMBER	Anode Diss. (W)	Cooling‡	Nom. Amp. Factor	Nom. Gm (mmhos)	Fl Freq. (GHz)	Upper Useful Freq. (GHz)
110,000	62,000	plate	6.0	0.0033	8941	750	C&C & FA	200	75	3.0	3.5
86,000	54,000	plate	6.0	0.0033	8942	750	C&C & FA	200	75	3.0	3.5
81,500	47,000	grid	6.0	0.0033	8941	750	C&C & FA	115	90	3.0	3.5
57,500	36,000	grid	6.0	0.0033	8942	750	C&C & FA	115	90	3.0	3.5
29,000	18,000	plate	6.0	0.0033	8940	750	C&C & FA	65	100	3.0	4.0
27,000	16,500	plate	6.0	0.0033	Y-518	150	C&C & FA	135	40	3.0	3.5
23,000	14,200	grid	6.0	0.0033	8940	750	C&C & FA	65	100	3.0	4.0
23,000	13,000	plate	6.0	0.0033	8533	100	C&C & FA	145	30	3.0	3.5
23,000	13,000	plate	6.0	0.0033	8755 8755A	150	C&C or FA	135	30	3.0	3.5
22,500	12,500	grid	6.0	0.0033	Y-518	150	C&C or FA	135	40	3.0	3.5
19,500	10,500	grid	6.0	0.0033	8533	100	C&C & FA	145	30	3.0	3.5
19,500	10,500	grid	6.0	0.0033	8755 8755A	150	C&C or FA	135	30	3.0	3.5
10,000	6400	plate	6.0	0.0033	Y-519	150	C&C or FA	75	40	3.0	3.5
8400	5250	plate	6.0	0.0033	7211	100	C&C & FA	80	30	3.0	3.5
8400	5250	plate	6.0	0.0033	7698	10	C&C	80	30	3.0	3.5
8400	5250	plate	6.0	0.0033	8403	100	C&C & FA	80	30	3.0	3.5
8400	5250	plate	6.0	0.0033	8757	150	C&C or FA	75	30	3.0	3.5
8400	5250	plate	6.0	0.0033	8847 8847A	150	C&C or FA	75	30	3.0	3.5
8400	5800	plate	6.0	0.004	8893	100	C&C or FA	60	30	4.0	4.5
7200	4500	grid	6.0	0.0033	Y-519	150	C&C or FA	75	40	3.0	3.5
6000	3750	grid	6.0	0.0033	7211	100	C&C & FA	80	30	3.0	3.5
6000	3750	grid	6.0	0.0033	7698	10	C&C	80	30	3.0	3.5
6000	3750	grid	6.0	0.0033	8403	100	C&C & FA	80	30	3.0	3.5

* Useful power output is that delivered to the load. Figures shown are approximate & dependent on circuit efficiency.

† Pulse derating data is available for most types for operation with longer pulses and/or higher duty.

‡ C&C: conduction & convection FA: forced air

PLANAR TRIODE TYPES

FOR GRID OR PLATE PULSED RF POWER AMPLIFIER SERVICE

OPERATIONAL DATA					RATING/DESIGN DATA						
Useful RF * Pwr Out (W) @ 1.0 GHz	Useful RF * Pwr Out (W) @ 3.0 GHz	Pulsed Element	Pulse Width (μs) †	Duty †	EIMAC TYPE NUMBER	Anode Diss. (W)	Cooling ‡	Nom. Amp. Factor	Nom. Gm (mmhos)	Fl Freq. (GHz)	Upper Useful Freq. (GHz)
6000	3750	grid	6.0	0.0033	8757	150	C&C or FA	75	30	3.0	3.5
6000	3750	grid	6.0	0.0033	8847 8847A	150	C&C or FA	75	30	3.0	3.5
5000	2900	plate	3.0	0.0025	7289 8250	100	C&C & FA	100	25	3.0	3.5
5000	2900	plate	6.0	0.0033	7815	10	C&C	100	25	3.0	3.5
5000	2900	plate	6.0	0.0033	7815R	100	C&C & FA	100	25	3.0	3.5
5000	3150	plate	6.0	0.0033	8756	150	C&C & FA	100	25	3.0	3.5
5000	3150	plate	6.0	0.0033	7855	100	C&C & FA	80	25	3.0	3.5
5000	3150	plate	6.0	0.0033	Y-503	100	C&C & FA	80	25	3.0	3.5
4950	3350	grid	6.0	0.004	8893	100	C&C & FA	60	30	4.0	4.5
3700	2700	plate	3.0	0.0025	8892	50	C&C & FA	60	30	6.0	7.0
3500	2000	grid	3.5	0.0025	7815	10	C&C	100	25	3.0	4.0
3500	2000	grid	3.5	0.0025	7815R	100	C&C & FA	100	25	3.0	4.0
3500	2250	grid	6.0	0.0033	8756	150	C&C & FA	100	25	3.0	4.0
3500	2250	grid	6.0	0.0033	7855	100	C&C & FA	80	25	3.0	4.0
3500	2250	grid	6.0	0.0033	Y-503	100	C&C & FA	80	25	3.0	3.5
3050	2150	grid	3.0	0.0025	8892	50	C&C & FA	60	30	3.0	7.0
1400	835	grid	3.0	0.0025	7289 8250	100	C&C & FA	100	25	3.0	4.0

AF POWER AMPLIFIER

or

MODULATOR SERVICE

AF Power Output (kW) TYPICAL (2 tubes)	Per Tube TYPICAL Plate Diss. (kW)	Class of Service	Driving Power (2 tubes) (W)	Cooling	EIMAC Quick Ref. Catalog Page No.*	EIMAC Type No.	Type of Tube
1900	420	AB1	0	Water	--	X-2159	Tetrode
950	210	AB1	0	Water	--	X-2170	Tetrode
660	260	AB1	0	Vapor	38	4CV250,000A	Tetrode
660	260	AB1	0	Water	36	4CW250,000A	Tetrode
246	57	AB1	0	Vapor	38	4CV100,000C	Tetrode
246	57	AB1	0	Water	35	4CW100,000D	Tetrode
200	46	AB1	0	Water	35	4CW100,000E	Tetrode
195	42	AB1	0	Water	35	4CW50,000E	Tetrode
195	42	AB1	0	Vapor	37	4CV50,000E	Tetrode
195	42	AB1	0	Vapor	6	4CV50,000J	Tetrode
195	42	AB1	0	Water	6	4CW50,000J	Tetrode
165	30.5	AB1	0	Vapor	38	4CV75,000A	Tetrode
152	44	AB2	600	Water	21	6696A	Triode
152	44	AB2	600	Air	18	6697A	Triode
152	44	AB2	600	Vapor	22	7480	Triode
70	20	AB1	0	Air	33	4CX35,000C	Tetrode
66	20.5	AB1	0	Vapor	37	4CV35,000A	Tetrode
57	14	AB1	0	Water	35	4CW25,000A	Tetrode
57	14	AB1	0	Air	33	4CX15,000A	Tetrode
35	12.5	AB1	0	Vapor	37	4CV20,000A	Tetrode
31.9	9	AB1	0	Air	33	4CX10,000D	Tetrode
29.1	10	AB1	0	Air	16	3CX10,000A1	Triode
29.1	10	AB1	0	Water	20	3CW20,000A1	Triode
17.5	4.2	AB1	0	Air	32	4CX5000A	Tetrode
17.5	4.2	AB1	0	Air	32	4CX5000R	Tetrode

* Catalog No. 171

AF POWER AMPLIFIER

or

MODULATOR SERVICE

AF Power Output (W) TYPICAL (2 tubes)	Per Tube TYPICAL Plate Diss. (W)	Class of Service	Driving Power (2 tubes) (W)	Cooling	EIMAC Quick Ref. Catalog Page No.	EIMAC Type No.	Type of Tube
14,500	4750	AB1	0	Vapor	37	4CV8000A	Tetrode
13,000	2500	B	113	Water	18	3CW5000A3	Triode
13,000	2500	B	113	Air	13	3CX2500A3	Triode
13,000	2500	B	113	Air	14	3CX2500F3	Triode
13,000	2500	B	113	Water	19	3CW5000F3	Triode
11,400	3300	AB1	0	Air	32	4CX3000A	Tetrode
10,000	2950	AB1	0	Water	18	3CW5000A1	Triode
10,000	2950	AB1	0	Water	18	3CW5000F1	Triode
10,000	2950	AB1	0	Air	14	3CX3000A1	Triode
10,000	2950	AB1	0	Air	14	3CX3000F1	Triode
3900	900	AB2	4.7	Air	25	4-1000A	Tetrode
3220	920	AB1	0	Air	40	5CX1500A	Pentode
3200	920	AB1	0	Air	31	4CX1500A	Tetrode
1720	500	AB1	0	Air	5	4-500A	Tetrode
1664	458	AB1	0	Air	39	5-500A	Pentode
1650	400	AB2	3.5	Air	24	4-400A	Tetrode
1750	400	AB2	3.5	Air	24	4-400C	Tetrode
1500	400	AB1	0	Air	24	4-400B	Tetrode
1420	445	AB2	25	Air	13	3-500Z	Triode
1310	340	B	26	Air	12	3-400Z	Triode
1040	190	AB2	1.9	Air	23	4-250A	Tetrode
800	225	AB1	0	Air	29	4CX300A	Tetrode
600	200	AB1	0	Air	27	4CX250B 4CX250F 4X150A 4X150D	Tetrode
400	125	AB2	1.0	Air	23	4-125A	Tetrode
270	63	AB2	1.3	Air	23	4-65A	Tetrode

OSCILLATOR OR AMPLIFIER

CLASS C

INDUSTRIAL APPLICATION

Plate Pwr. Output (kW) TYPICAL *	Plate Dissipation (Rated kW)	Freq. (MHz) † F1 / upper useful	Socket & Accessories Available or req'd	Cooling	EIMAC Quick Ref.Catalog Page No. ‡	EIMAC Type Number	Type of Tube
1800	1000	30 / 60	---	Water	---	X2176	Triode
900	500	30 / 60	---	Water	---	X2177	Triode
80	60	40 / 80	as follows: SK-1610 fil.small connector SK-1611 fil.large connector SK-1612 grid connector SK-1620 anode water jacket SK-1625 mounting clamp SK-1626 mounting plate	Water	21	6696A	Triode
80	35	40 / 80	as follows: SK-1606A air distributor SK-1606B tube support SK-1610, SK-1611, SK-1612 - same as for Type 6696A	Air	18	6697A	Triode
80	80	40 / 80	as follows: BR-400 anode boiler SK-1610, SK-1611, SK-1612 . same as for Type 6696A	Vapor	22	7480	Triode
70	40	90 / ---	None Req'd	Water	21	3CW40,000H3	Triode
60	20	90 / ---	None Req'd	Air	17	3CX20,000H3	Triode
42	30	90 / ---	None Req'd	Water	21	3CW30,000H3	Triode
42	30	100 / ---	as follows: BR-200 boiler	Vapor	22	3CV30,000H3	Triode
41.2	15	90 / ---	None Req'd	Air	17	3CX15,000H3	Triode
29	10	90 / ---	None Req'd	Air	16	3CX10,000H3	Triode
28	20	90 / ---	None Req'd	Water	20	3CW20,000H3	Triode
20.6	10	90 / ---	None Req'd	Water	19	3CW10,000H3	Triode
18.6	5	90 / ---	None Req'd	Air	15	3CX5000H3	Triode
10	5	75 / 150	None Req'd	Water	19	3CW5000H3	Triode
5	2.5	75 / 150	Fil.collets available	Air	13,14	3CX2500A3, F3, & H3	Triodes
1.2	0.3	40 / 80	Johnson #124-213	Convection & Radiation	--	304TL	Triode
0.685	0.350	100 / ---	as follows: SK-410 socket SK-406 chimney	Air	12	5867A	Triode

* Calculated or measured at low frequency

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

‡ Catalog #171.

Maximum Pass Current (Adc)	Maximum Hold-off Voltage (kVdc)	Minimum Tube Drop (Vdc)	Anode Dissipation (Rated kW)	Cooling	EIMAC Quick Ref. Catalog Page No. *	EIMAC Type Number	Type of Tube
50	40	4400	250	Water	36	4CW250,000A	Tetrode
35	40	2700	100	Water	35	4CW100,000E	Tetrode
30	40	3300	100	Water	35	4CW100,000D	Tetrode
15	35	3000	50	Water	35	4CW50,000E	Tetrode
15	40	2200	35	Air	33	4CX35,000C	Tetrode
7.5	10	1500	20	Water	20	3CW20,000A1	Triode
7.5	20	1200	20	Water	20	3CW20,000A7	Triode
7	10	1300	12	Air	16	3CX10,000A1	Triode
6	20	800	25	Water	35	4CW25,000A	Tetrode
4	20	500	15	Air	4	3CX15,000A7	Triode
4	15	2000	10	Water	34	4CW10,000A	Tetrode
3	12	1300	5	Water	18	3CW5000A1	Triode
3	8	500	1.5	Air	3	3CX1500A7	Triode
2.5	18	1500	5	Air	41 (See Type 290)	Y-573	Pentode
2	18	1000	3	Air	41 (See Type 264)	Y-574	Pentode
2	12	1000	3	Air	14	3CX3000F1	Triode
2	6	1000	2	Water	34	4CW2000A	Tetrode
1.4	6	600	1	Air	31	4CX1000A	Tetrode
1	6	500	0.8	Water	34	4CW800B	Tetrode
1	6	500	0.8	Water	34	4CW800F	Tetrode
0.8	4.5	300	0.4	Air	3	8874	Triode
0.8	4.5	300	0.3	Air	3	8875	Triode
0.8	4.5	300	0.2	Convection	3	8873	Triode
0.6	30	500	1	Air	43	4PR1000A	Tetrode
0.6	8	400	0.5	Air	13	3-500Z	Triode
0.4	4	600	0.3	Water	36	4W300B	Tetrode
0.2	20	1800	0.4	Air	43	4PR400A	Tetrode
0.2	50	1000	0.25	Air	43	4PR250C	Tetrode
0.1	18	1200	0.125	Air	42	4PR125A	Tetrode
0.1	15	500	0.065	Convection	42	4PR65A	Tetrode

* Catalog No. 171

SWITCH TUBE OR PULSED REGULATOR SERVICE

Peak Anode Current (a)	Maximum Hold-off Voltage (kVdc)	Anode Dissipation (Rated kW)	Cooling	EIMAC Quick Ref. Catalog Page No. †	EIMAC Pulse Eng. Newsletter Page No. ‡	EIMAC Type Number	Type of Tube	Comment
780	60	1250	water	--	--	X2159	tetrode	
400	60	650	water	--	--	X2170	tetrode	
300	40	250	water	36	1	4CW250,000A	tetrode	
150	75	35	air	--	7	Y-546	tetrode	Specially processed 4CX35,000C
150	40	100	water	35	3	4CW100,000D	tetrode	
150	40	100	water	35	1	4CW100,000E	tetrode	
150	40	35	air	33	3	4CX35,000C	tetrode	
130	25	60	water	21	3	6696A	triode	
130	25	35	air	18	3	6697A	triode	
100	35	50	water	35	1	4CW50,000E	tetrode	
100	35	50	vapor	37	1	4CV50,000E	tetrode	
70	20	25	water	35	--	4CW25,000A	tetrode	
70	20	15	air	33	3	4CX15,000A	tetrode	
60	30	15	air	--	--	Y-456	tetrode	Specially processed 4CX15,000A
50	30	25	water	--	7	Y-569	tetrode	Prototype:4CW25,000A
40	15	10	air	33	1	4CX10,000D	tetrode	
40	18	5	air	--	7	Y-573	pentode	Specially processed Type 290
40	18	3	air	--	7	Y-574	pentode	Specially processed Type 8576/264
40	20	6.0	water	--	--	Y-633	tetrode	Prototype: 4CX5000R
40	20	20	water	20	--	3CW20,000A7	triode	
40	15	5	air	32	1	4CX5000A	tetrode	
40	15	5	air	32	1	4CX5000R	tetrode	
40	25	10	water	--	7	Y-442	tetrode	Prototype: 4CX5000R
25	20	3	air	32	1	4CX3000A	tetrode	
18	20	0.06	air	42	3	4PR60C	tetrode	
12	12	1	air	--	7	Y-575	pentode	Specially processed 8295A
12	4	0.6	air	30	--	4CX600B & F	tetrode	
12	4	0.8	water	34	--	4CW800B & F	tetrode	

† Catalog No. 171

‡ EIMAC Engineering Newsletter SUMMARY OF EIMAC TUBES FOR PULSE OR SWITCH SERVICE available on request

SWITCH TUBE OR PULSED REGULATOR SERVICE

Peak Anode Current (a)	Maximum Hold-off Voltage (kVdc)	Anode Dissipation (Rated W)	Cooling	EIMAC Quick Ref. Catalog Page No. †	EIMAC Pulse Eng. Newsletter Page No. ‡	EIMAC Type Number	Type of Tube	Comment
12	25	750	air	--	--	8941	planar triode	
12	20	750	air	--	--	8942	planar triode	
12	6.5	750	air	--	--	8940	planar triode	
10	7	1500	air	40	1	4CX1500A	tetrode	
8	30	1000	air	43	3	4PR1000A	tetrode	
8	40	1000	air	--	7	Y-364	tetrode	specially processed 4PR1000A
8	30	1000	air	43	3	4PR1000B	tetrode	
6	15	150	air	--	--	Y-634	planar triode	
6	12	150	air	--	7	Y-518	planar triode	
6	7	250	air	29	1	4CPX250K	tetrode	
6	4	150	air	--	7	Y-519	planar triode	
5	12	150	air	--	7	Y-540	planar triode	
5	10	150	air	--	7	Y-532	planar triode	
5	10	100	air	10	5	8533	planar triode	
5	10	150	air	11	5	8755	planar triode	
5	6	150	air	--	7	Y-483	planar triode	
5	4	150	air	--	5	8847	planar triode	
5	3.5	100	air	8	3	7211	planar triode	
5	3.5	150	air	11	5	8757	planar triode	
5	3.5	100	air	10	5	8403	planar triode	
4	50	250	air	43	3	4PR250C	tetrode	
4	20	400	air	43	3	4PR400A	tetrode	
3	10	400	air	--	7	Y-504	triode	Specially processed 3-400Z
3	4.5	100	air	--	3	7815RAL	planar triode	
3	3.5	100	air	9	1	7815R	planar triode	
3	3.5	100	air	10	3	7855	planar triode	
3	3.5	150	air	11	5	8756	planar triode	

SWITCH TUBE OR PULSED REGULATOR SERVICE

Peak Anode Current (a)	Maximum Hold-off Voltage (kVdc)	Anode Dissipation (Rated W)	Cooling	EIMAC Quick Ref. Catalog Page No. †	EIMAC Pulse Eng. Newsletter Page No. ‡	EIMAC Type Number	Type of Tube	Comment
2.1	18	125	air	42	3	4PR125A	tetrode	
1.5	4.5	100	air	10	5	8745	planar triode	
1.2	15	65	convection	42	3	4PR65A	tetrode	

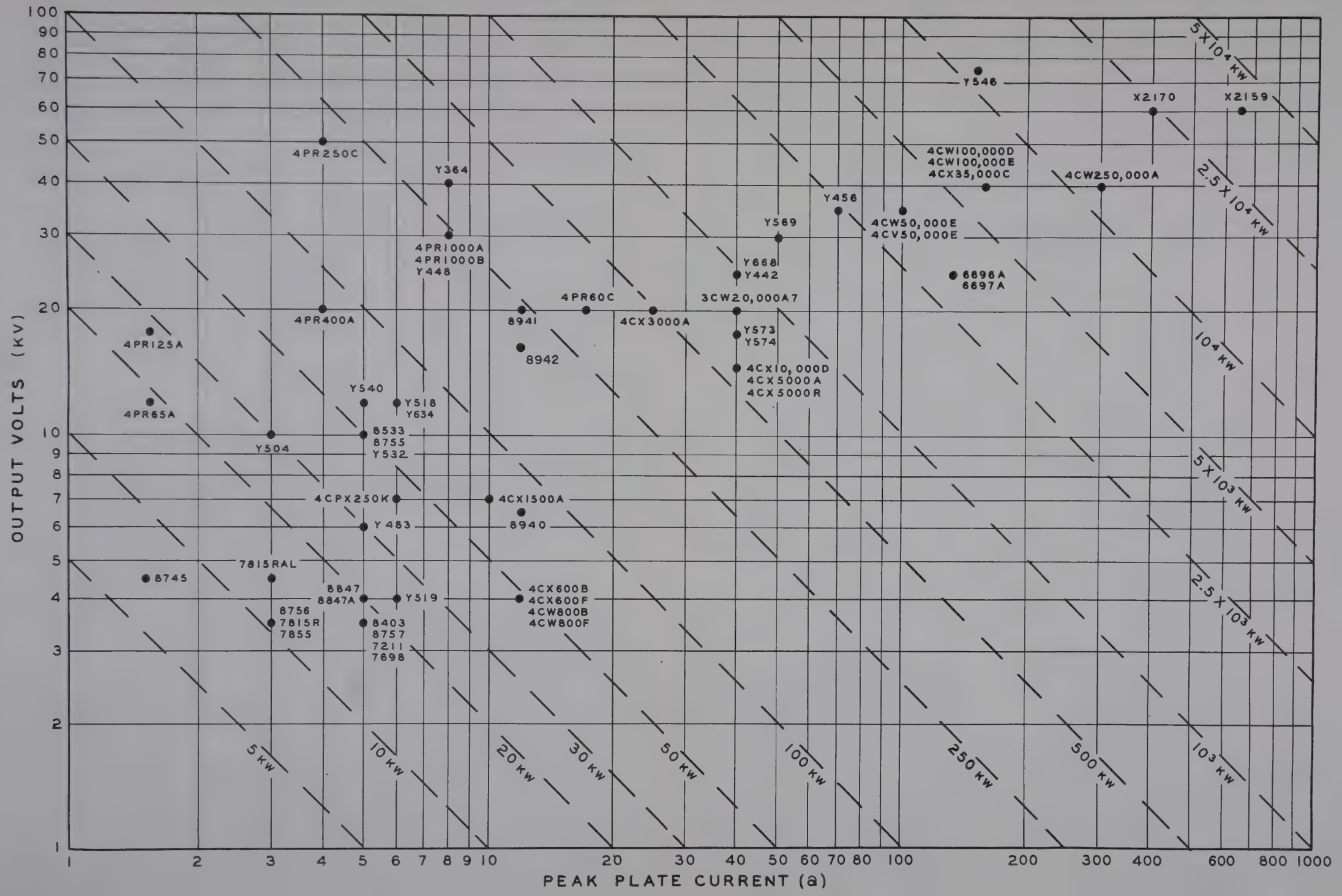
EIMAC POWER GRID TUBES

SWITCH TUBE OR PULSED REGULATOR SERVICE

This chart displays EIMAC power grid tubes recommended for switch tube or pulsed regulator service. Pulse output voltage is plotted against pulse plate current so that the peak switching power capability of these tubes may be conveniently compared.

Any tube may be used within the area defined by the rectangle below and to the left of the coordinate for that tube. The constant power lines indicate the modulator peak output capability of each type.

Pulse duration capability and pulse duration derating curves are available for many types, and the Engineering Newsletter SUMMARY OF EIMAC TUBES FOR PULSE OR SWITCH SERVICE is also available on request. Contact the Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, Can Carlos, CA 94070, for information and recommendations.


EIMAC POWER GRID TUBES - SWITCH TUBE OR PULSED REGULATOR SERVICE
OUTPUT VOLTS (KV)
PEAK PLATE CURRENT (a)
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
100
200
300
400
600
800
1000
5 KW
10 KW
20 KW
30 KW
50 KW
100 KW
250 KW
500 KW
10³ KW
2.5 X 10³ KW
5 X 10³ KW
10⁴ KW
2.5 X 10⁴ KW
5 X 10⁴ KW
4PR250C
Y364
4PR1000A
4PR1000B
Y448
4PR400A
4PR125A
4PR65A
4PR60C
8941
8942
4CX3000A
3CW20,000A7
Y573
Y574
4CX10,000D
4CX5000A
4CX5000R
Y668
Y442
Y589
Y456
4CW50,000E
4CV50,000E
Y546
4CW100,000D
4CW100,000E
4CX35,000C
6696A
6697A
X2170
X2159
4CW250,000A
Y540
Y518
Y634
8533
8755
Y532
Y504
4CPX250K
4CX1500A
8940
Y483
8745
7815RAL
8847
8847A
Y519
8756
7815R
7855
8403
8757
7211
7698
4CX600B
4CX600F
4CW800B
4CW800F

varian
electron tube and device group

U.S. SALES OFFICES

Boston
400 Totten Pond Road
Building 1
Waltham, Mass 02154
TEL: (617) 890-4560

Chicago
205 W. Touhy Avenue
Park Ridge, Illinois 60068
TEL: (312) 825-6686

Dallas
Richardson Savings & Loan Bldg.
558 So. Central Expressway
Suite 202
P.O. Box 689
Richardson, Texas 75080
TEL: (214) 235-2385

Dayton
Southmoor Building
10 Southmoor Circle
Dayton, Ohio 45429
TEL: (513) 298-7318

Ft. Lauderdale
1101 E. Sample Rd., Suite 106
Light House Point, Fl. 33064
TEL: (305) 943-9495

Atlanta Branch
180 Allen Rd., N.W.
Suite 202
Atlanta, Georgia 30328
TEL: (404) 252-0045

Clearwater Branch
314 South Missouri
Suite 205
Clearwater, Fla. 33516
TEL: (813) 446-8513

Los Angeles
2901 Wilshire Boulevard, Suite 102
Santa Monica, Calif. 90403
TEL: (213) 828-5588

New York
#25 Route 22
Springfield, New Jersey 07081
TEL: (201) 376-6600

Philadelphia
P.O. Box 256
Cherry Hill, New Jersey 08002
TEL: (609) 428-6800

Phoenix
7117 Third Avenue, Suite 106
Scottsdale, Arizona 85251
TEL: (602) 947-5461

Albuquerque Branch
3520 Pan American Freeway, N.E.
Suite 7
Albuquerque, N. Mexico 87107
TEL: (505) 345-3827

San Francisco
4940 El Camino Real
Los Altos, California 94022
TEL: (415) 968-7630

Syracuse
115 Twin Oaks Drive
Syracuse, New York 13206
TEL: (315) 437-2568

Washington, D.C.
4701 Lydell Drive
Cheverly, Maryland 20785
TEL: (301) 773-7010 thru 7017

INTERNATIONAL SALES OFFICES

Australia
Varian Pty. Ltd.
82 Christie Street
St. Leonards 2065
New South Wales, Australia
TEL: 43-0673

Varian Pty. Ltd.
679 Springvale Road
North Springvale, VICT. 3170
Australia
TEL: 560-7133

Benelux
Varian Benelux N.V.
Maassluisstraat 100
P.O. Box 9158
Amsterdam, Holland
TEL: (020) 15 94 10

Brazil
Varian Industria e Comercio Ltda.
Alameda Lorena 1834
Sao Paulo, - SP - Brazil
TEL: 80-80-27

Canada
Varian Associates of Canada, Ltd.
45 River Drive
Georgetown, Ontario, Canada
TEL: (416) 457-4130

France
Varian S.A.
Quartier de Courtaboeuf
Boite Postale No. 12
91401 Orsay, France
TEL: 907-78-26

Germany
Varian GmbH
Breitwiesenstrasse 9
7 Stuttgart 80 (Vaihingen)
Germany
TEL: (0711) 73 20 28

Italy
Varian SpA
Via Fratelli Varian
10040 Leini (Torino)
Italy
TEL: (011) 26 80 86

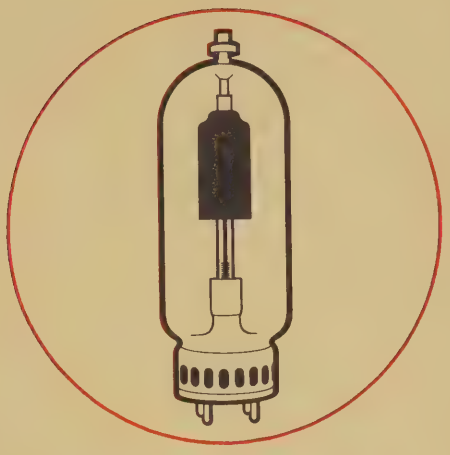
Japan
Marubun Corporation
1-1, Nihombashi Odemmacho 2-Chome
Chuo-Ku, Tokyo, 103 Japan
TEL: (03) 662-8151

Scandinavia
Varian AB
Skytteholmsvagen 7D
P.O. Box 1099
17122 Solna 1, Sweden
TEL: (08) 82 00 30

Switzerland
Varian AG
Steinhauserstrasse
6300 Zug, Switzerland
TEL: (042) 23 25 75

United Kingdom and Ireland
EMI - Varian Ltd
Blyth Road
Hayes,
Middlesex
England
TEL: 01-573 5555

Printed in U.S.A.



diodes·rectifiers

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

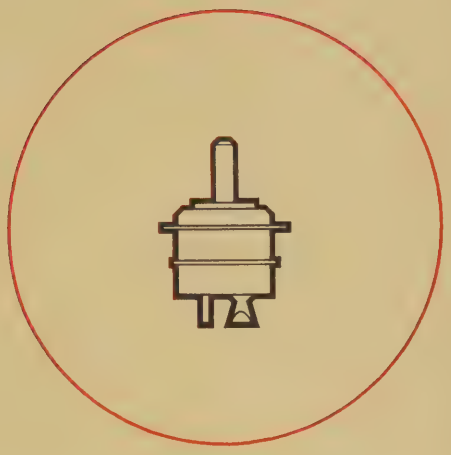
Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.



planar triodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

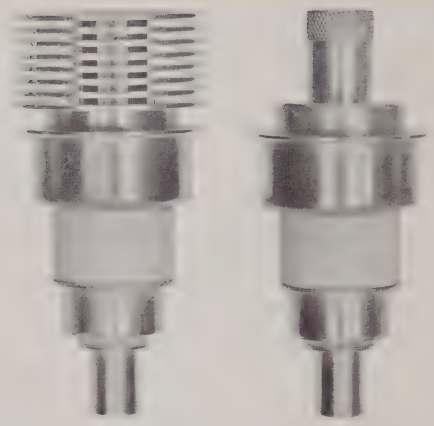
Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

7855AL
7855KAL

PLANAR TRIODE



7855AL 7855KAL

The EIMAC 7855AL and 7855KAL are ceramic/metal planar triodes specially processed and tested to assure high reliability in airborne service. Evaluation of these tubes is based upon operating conditions found in commercial airborne applications such as transponders. The testing emphasizes cathode emission capability at reduced heater voltage and high voltage hold-off, both features which are demanded in airline service.

The 7855AL is derived from the 7855, the 7855KAL from the 7855K. These new improved tubes also contain features of the original types such as a frequency stable anode, rugged ceramic/metal construction, low interelectrode capacitance, high transconductance and high mu.

In addition to these features, these tubes also incorporate the arc-resistant cathode which assures stable operation under adverse conditions and which minimizes catastrophic failures due to arc-over during circuit malfunction. These tubes are useable from dc to 3 GHz.

The 7855KAL utilizes conduction-convection cooling. The 7855AL is supplied with a radiator for forced-air cooling. Except for the plate dissipation ratings, the two tubes have identical electrical characteristics.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.7 ± 2%	V
Current, at 5.7 volts	0.95	A
Transconductance (Average):		
Ib = 70 mAdc, Eb = 600 Vdc	25	mmhos
Amplification Factor (Average)	100	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	6.80	pF
Cout	0.04	pF max.
Cgp	2.50	pF
Cut-off Bias [3]	-30	V
Frequency of Maximum Rating:		
Plate or Grid-Pulsed	3000	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pf due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Effective 3-1-72) © by Varian Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length (7855AL)	2.386 in; 60.60 mm
(7855KAL)	2.386 in; 60.60 mm
Diameter (7855AL)	1.264 in; 32.11 mm
(7855KAL)	1.195 in; 30.35 mm
Net Weight (7855AL)	2.01 oz; 57 gm
(7855KAL)	1.41 oz; 40 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling - 7855AL (With Radiator)	Forced Air
- 7855KAL (Without Radiator)	Conduction and Convection
Terminals	Coaxial special

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.7 volts	0.87	1.02	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	6.00	7.50	pF
Cout	---	0.40	pF
Cgp	2.35	2.65	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	2500 VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	3500 VOLTS
DC GRID VOLTAGE	-150 VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE	
Grid negative to cathode	-750 VOLTS
Grid positive to cathode	250 VOLTS
PULSE PLATE CURRENT	3.0 AMPERES
PULSE GRID CURRENT	1.8 AMPERES
AVERAGE PLATE DISSIPATION	
Conduction and convection(7855KAL)	10 WATTS
Forced Air(7855AL)[1]	35 WATTS
GRID DISSIPATION (Average)	2.0 WATTS
FREQUENCY	3.0 GHz
PULSE DURATION[2]	6.0 μs
DUTY FACTOR[2]	.0033

1. Using EIMAC radiator PN 158601.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City,

OPERATING CONDITIONS

GRID PULSED OSCILLATOR

Frequency	1.090 GHz
Heater Voltage	5.7 V
DC Plate Voltage	2000 Vdc
DC Grid Voltage	-75 Vdc
Peak Video Plate Current	1.3 a
Peak Video Grid Current	0.8 a
Useful Power Output (approx.)	750 w
Pulse Duration	0.5 μs
Duty Factor	0.001

PLATE PULSED AMPLIFIER

Frequency	1.1 GHz
Heater Voltage	5.7 V
Peak Plate Voltage	2000 v
Peak Video Plate Current	1.8 a
Peak Video Grid Current	1.0 a
Useful Power Output (approx.)	1800 w
Pulse Duration	3.5 μs
Duty Factor	0.001
Gain	8 db
Plate Efficiency	50 %

APPLICATION

MECHANICAL

MOUNTING - The important dimensions of the tube are carefully controlled with respect to the reference surface as shown on the outline drawing. The reference surface is intended to serve as a tube stop and the location of the tube in the circuit should therefore be determined by this surface coming in positive contact with a precisely positioned member of the socket or cavity. Adherence to this practice will assure both mechanical and electrical interchangeability of all tubes of a given type. If a non-designated surface is used as a tube stop, faulty positioning of the tube in the cavity and possible incomplete electrical contact can result in improper tuning, reduced power output and damage to the cavity, tube or both. Contact surfaces, with reference to the designated tube stop are shown in the outline drawing. Electrical contact to the cathode, grid, anode and also the heater should be restricted to these designated contact areas.

Dimensions should never be taken from sample tubes. Dimensional changes due to normal variations in undimensioned surfaces may occur within the limits specified on the outline drawing. Use of nondesignated electrical contact surfaces might therefore result in incomplete contact or mechanical interference, causing changes in cavity tuning.

Electrical contact should be made by spring finger collets bearing against the previously described contact areas. If connections are employed which do not provide multiple contacts to the designated contact areas, concentration of RF current will result in loss of output power, especially at higher frequencies. The spring contacts used should exert a firm pressure without gouging the plated contact surface. This latter phenomena can result in loose particles of material which can cause arcing or unstable operation of the cavity.

If the tubes are used in applications which call for severe shock or vibration the tube may be clamped in place by the knob or radiator, exerting pressure only on this part of the tube and against the tube stop. No other portion of the tube should be subject to any clamping force. In particular, electrical contacts which utilize setscrews or rigid clamps should be avoided. Such contact schemes can distort the contact surfaces causing undue stress in the metal-to-ceramic seal area which may result in a vacuum leak. Soldered electrical connections can be made, however great care should be taken during the solder operation to avoid fracture of the seal area due to thermal shock. All contact surfaces should be kept clean to minimize losses.

COOLING - The EIMAC planar triodes are designed to operate at envelope and anode temperatures of up to the maximum rated value of 250°C. However, performance and long-term reliability of any component are improved when it is kept as cool as technically feasible. Therefore, it is recommended that sufficient cooling be provided to keep the anode and seal areas well below the specified maximum temperature, where long tube life and high reliability are of great importance.

The maximum plate dissipation of the 7855KAL is 10 watts average power. This can be accomplished by conduction, natural convection or forced air convection cooling. The maximum plate dissipation of the 7855AL in pulse service is 35 watts average and forced air cooling must be employed at that level. When forced air cooling is used, it is recommended that additional airflow, apart from that flowing through the radiator be used to cool the tube envelope and other tube terminals. A certain amount of conduction cooling is usually inherent in the contact finger configuration. It should be noted, however, that spring fingers provide poor heat conduction and measurements have shown a temperature difference as much as 50°C between the contact finger and contact area.

It is suggested that in all new applications the envelope temperature be measured, especially if the tube is used close to the upper temperature limit. The temperature can easily be determined by the use of Tempilaq paint (Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield N.J. 07080) or Temp-Plate stickers (Pydrodyne, Inc., 1001 Colorado, Santa Monica, Calif. 90404).

ELECTRICAL

HEATER VOLTAGE - The rated heater voltage for either tube type is 5.7 volts and should be controlled within ±2% to obtain maximum tube life and to minimize variations in circuit performance. The rated heater voltage is optimum for most

existing airborne applications such as DME and transponder systems. However, there are other applications where a different heater voltage than the nominal should be used to obtain the longest possible tube life. Depending on pulse width, power output and frequency of oscillation used a different heater voltage may be better for long reliable life. Electron transit time is not necessarily small with respect to the period of oscillation and the amount of driving power diverted will contribute to the cathode heating by electron bombardment.

The proper adjustment of the heater voltage must be made to compensate for this additional heating, which depends on operating frequency and duty cycle employed.

INTERELECTRODE CAPACITANCES - As indicated, the capacitance values are shown for measurements made with no heater voltage. The cathode to grid and cathode to plate capacitance will increase with the application of the heater voltage, due to the thermal expansion of the cathode support. Typically, the increase in the grid to cathode capacitance will be 15%, or more, depending on the heater voltage. Since the heater voltage can vary depending on use, data taken without heater voltage is more useful for control of tube-to-tube uniformity. The grid to anode capacitance is not effected by the application of the heater voltage.

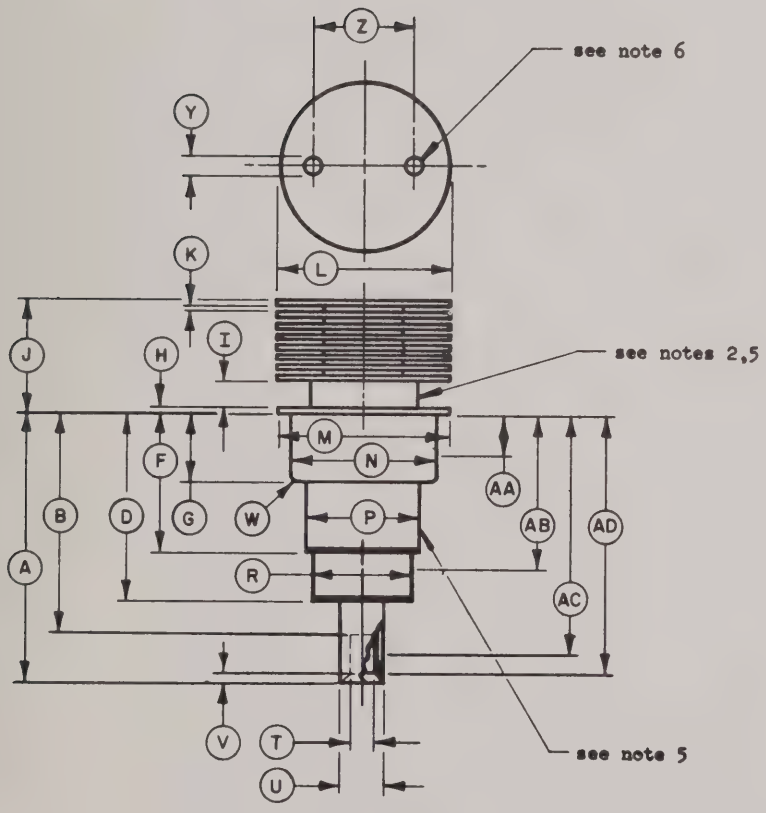
CIRCUIT TUNING - Especially under grid pulse conditions, it is important that the tube does not lose bias or momentarily go into a CW mode. Either of these events may result in tube failure. It is suggested that provision be made for initial circuit tune-up at reduced anode voltage and for extra tube protection when the circuit adjustment is critical. The average grid dissipation capability of these tubes is 2.0 watts. For many applications the limiting factor is often not anode dissipation or cathode emission capability, but grid dissipation. If pulse width control is lost in pulse applications the grid can exceed safe operating temperatures in 50 ms or less. Appropriate circuit protection during tune up is therefore recommended.

CATHODE OPERATION - The 7855AL and 7855KAL contain an arc-resistant cathode. Performance in the field and laboratory indicates these tubes are capable of withstanding some abuse due to high voltage arcs, however, poor circuit adjustment in the field may result in shortened tube life. It is, therefore, suggested that wherever feasible, the plate supply be designed such that its impedance limits the short circuit current to within five to ten times the maximum forward current. For pulse service the peak current should be limited to the values listed. Higher pulse width and duty cycles than given can be obtained with proper derating of the current. For this and special applications it is recommended that the user request additional information pertaining to his special application from the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

SPECIAL APPLICATION - For further operating information refer to EIMAC bulletin #15 "Operating Instructions for Planar Triodes".

ELECTRODE CONTACT DIMS. (see note 7)				
Dim. in Inches		Dim.	Dim. in Millim.	
Min.	Max.		Min.	Max.
.035	.361	AA	.89	9.17
1.021	1.101	AB	25.93	27.97
1.219	1.413	AC	30.96	35.89
1.160	1.500	AD	29.46	38.10

DIMENSIONAL DATA					
Dim. in Inches			Dim. in Millimeters		
Min.	Max.	Dim.	MIN.	MAX.	
1.500	1.560	A	38.10	39.62	
	1.214	B		30.84	
1.125	1.165	D	28.58	29.59	
.800	.840	F	20.32	21.34	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.046	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	
.213	.223	T	5.41	5.66	
.315	.325	U	8.00	8.26	
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	
.650	.850	Z	16.51	21.59	



NOTES:

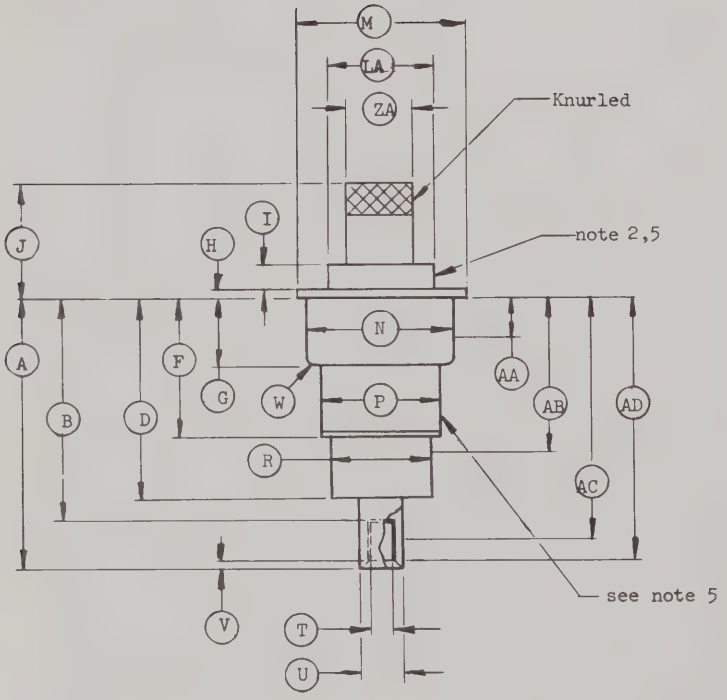
1. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.
2. This surface to be used to measure anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Holes for extractor thru top fin only.
7. Electrode Contact dims. are for socket design purposes & are not intended for inspection purposes.

ELECTRODE CONTACT AREA (see note 6)				
Dim. in Millimeters		Dim.	Dim. in Inches	
Min.	Max.		Min.	Max.
.89	9.17	AA	.035	.361
25.93	27.97	AB	1.021	1.101
30.96	35.89	AC	1.219	1.413
29.46	38.10	AD	1.160	1.500

DIMENSIONAL DATA				
Dim. in Inches		Dim. in Millimetres		
Min.	Max.	Dim.	MIN.	MAX.
1.500	1.560	A	38.10	39.62
	1.215	B		30.84
1.125	1.165	D	28.58	29.59
.800	.840	F	20.32	21.34
.462	.477	G	11.73	12.12
	.040	H		1.02
	.185	I		4.70
.766	.826	J	19.46	20.98
.025	.046	K	.64	1.17
1.234	1.264	L	31.34	32.11
1.180	1.195	M	29.97	30.35
1.025	1.035	N	26.04	26.29
.752	.792	P	19.10	20.12
.655	.665	R	16.64	16.89
.213	.223	T	5.41	5.66
.315	.325	U	8.00	8.26
	.086	V		2.18
	.100	W		2.54
.840	.860	LA	21.34	21.84
.427	.447	ZA	10.85	11.35

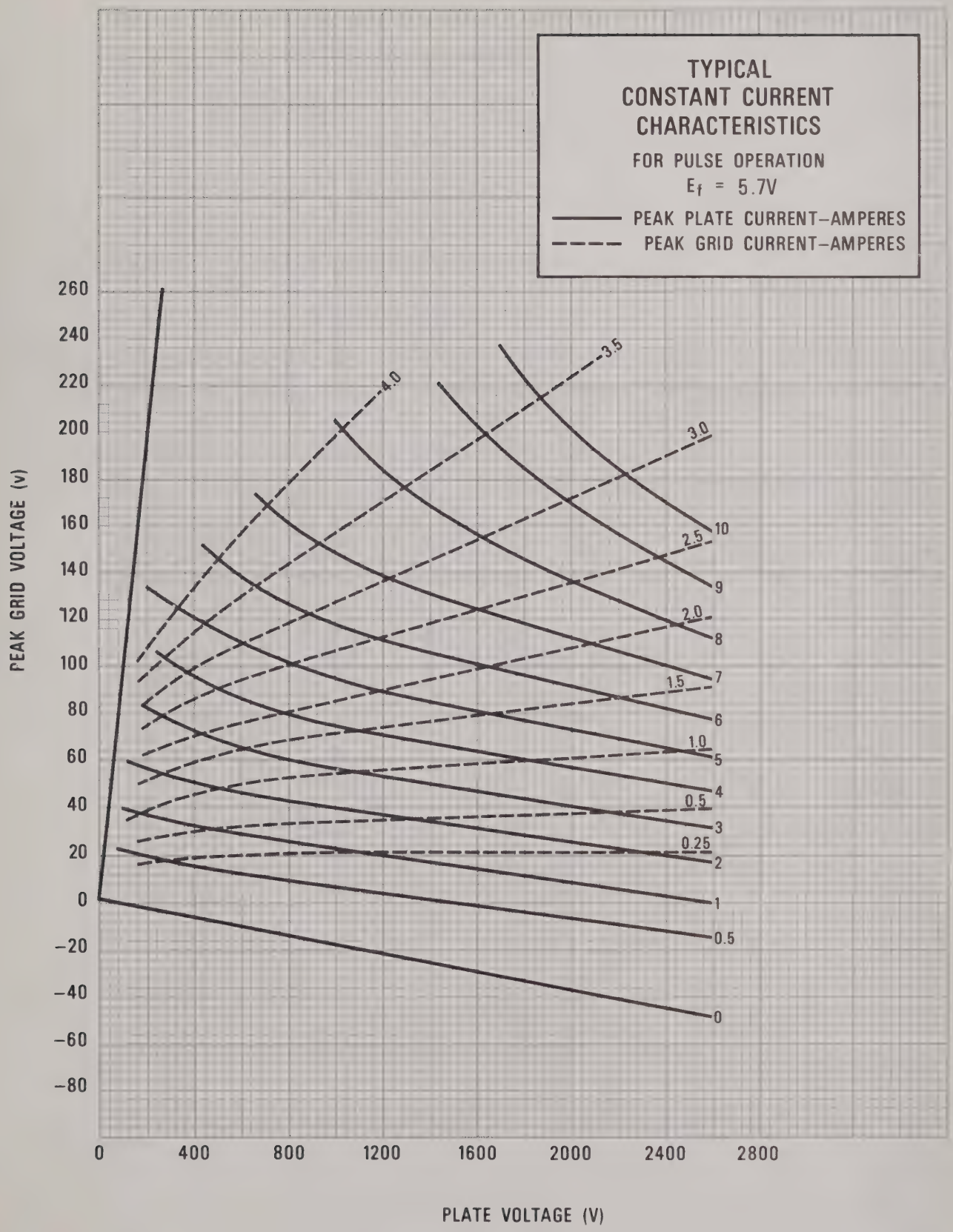


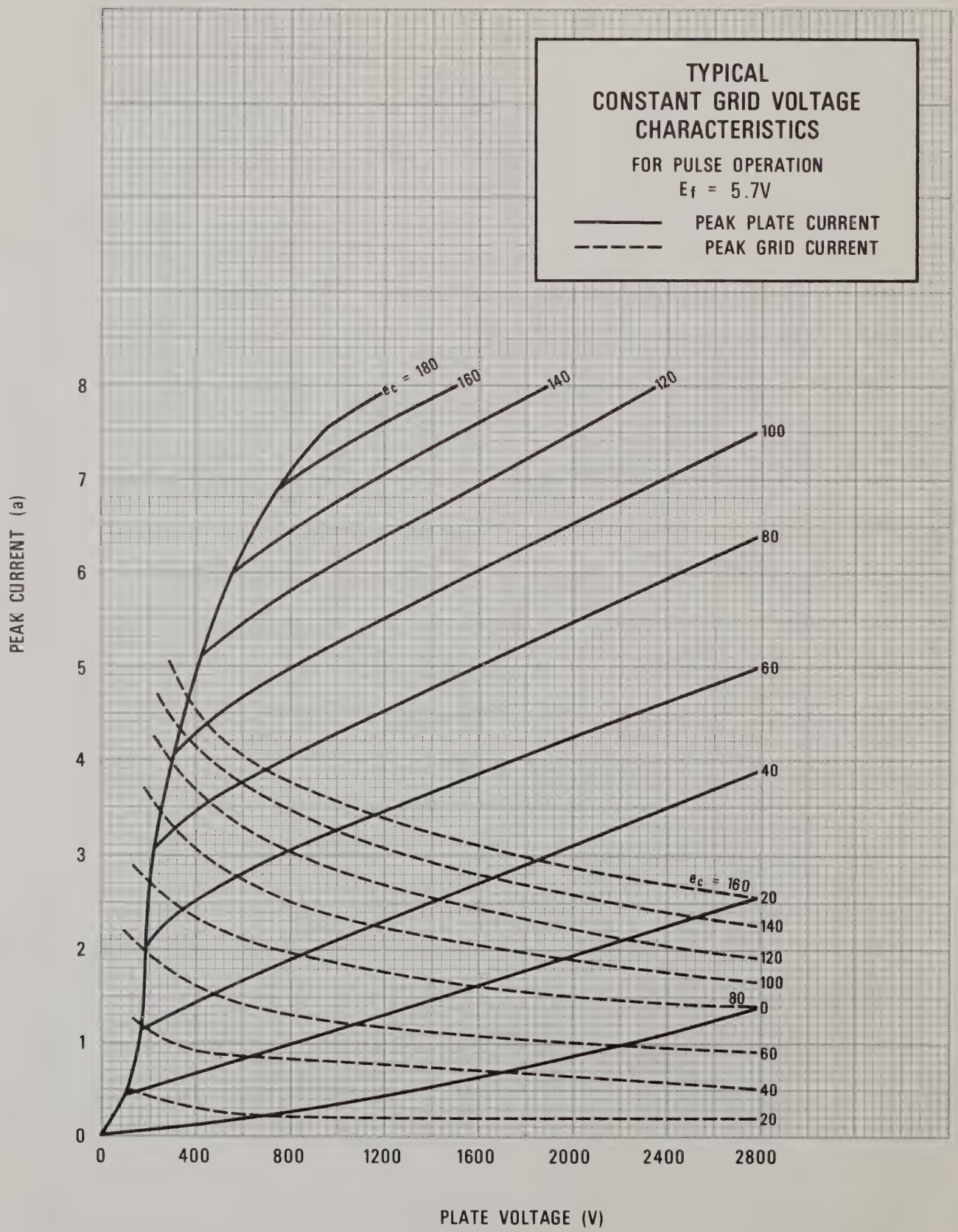
NOTES:

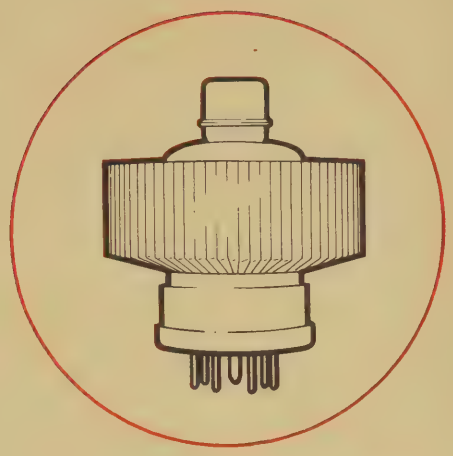
1. Metric equivalents to the nearest .01mm, are given for general information only & are based on 1 inch= 25.4 mm.
2. This surface shall be used to measure Anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T,U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Electrode Contact Dims. are intended for socket design only & are not intended for inspection purposes.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 5.7V
PEAK PLATE CURRENT–AMPERES
PEAK GRID CURRENT–AMPERES
PEAK GRID VOLTAGE (v)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
−20
−40
−60
−80
0
400
800
1200
1600
2000
2400
2800
PLATE VOLTAGE (V)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
10
9
8
7
6
5
4
3
2
1
0.5
0


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 5.7V
PEAK PLATE CURRENT
PEAK GRID CURRENT
PEAK CURRENT (a)
PLATE VOLTAGE (V)
0
1
2
3
4
5
6
7
8
0
400
800
1200
1600
2000
2400
2800
e_c = 180
160
140
120
100
80
60
40
20
0
e_c = 160
140
120
100
80
60
40
20



triodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

TECHNICAL DATA

8160
3CX10,000A7

HIGH-MU
POWER TRIODE



The EIMAC 8160/3CX10,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8160/3CX10,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-Tungsten	
Voltage	7.5 V
Current	100 A
Amplification Factor (Nominal)	200
Direct Interelectrode Capacitances:[2]	
Grid-Filament	59.0 pF
Grid-Plate	36.0 pF
Plate-Filament	0.2 pF
Frequency for Maximum Ratings	160 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Coaxial
Recommended Air-System Socket	EIMAC SK-1300
Recommended Air Chimney	EIMAC SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250 °C
Ceramic/Metal Seals	250 °C
Maximum Dimensions:	
Height	8.75 in; 222.25 mm
Diameter	7.05 in; 179.07 mm
Net Weight	12 lbs; 5.45 kg

(Revised 2-1-73) © 1963, 1967, 1973 by Varian Printed in U.S.A.

RADIO-FREQUENCY LINEAR AMPLIFIER

Grounded Grid, Class-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000	V
Zero-Signal DC Plate Current[1]	0.60	0.60	A
Max-Signal DC Plate Current	3.72	5.00	A
Max-Signal DC Grid Current	0.71	1.00	A
Driving Impedance	35	32	Ω
Resonant Load Impedance	1020	745	Ω
Max-Signal Driving Power	885	1540	w
Peak Envelope Plate Output Power.	17.7	24.2	kW
Power Gain	13	12	dB

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class B, Grid Driven

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000	V
DC Grid Voltage	0	0	V
Zero-Signal DC Plate Current[1]	1.20	1.20	A
Max-Signal DC Plate Current	7.50	10.0	A
Max-Signal DC Grid Current.	1.50	2.06	A
Driving Power	315	560	W
Peak AF Driving Voltage(Per Tube)	250	310	v
Load Resistance, Plate-to-Plate	2000	1520	Ω
Max-Signal Plate Output Power	35.6	47.7	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Carrier Conditions, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.
2. Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000	V
DC Grid Voltage	0	V
Zero-Signal DC Plate Current[1]	0.60	A
DC Plate Current	2.40	A
DC Grid Current	0.25	A
Driving Impedance[2]	32	Ω
Peak Driving Voltage[2]	310	v
Driving Power	330	W
Plate Output Power	5650	W

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10	KILOWATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	7600	V
DC Plate Current	3.68	A
DC Grid Voltage	-110	V
DC Grid Current	775	mA
Peak RF Cathode Voltage	400	v
Cathode Driving Power [1]	1510	W
Plate Output Power	22.5	kW

1. Approximate value.

PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	6.5	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION

DC Plate Voltage	5000	V
DC Plate Current	3.0	A
DC Grid Voltage	-200	V
DC Grid Current	775	mA
Peak RF Grid Voltage	490	v
Grid Driving Power [1]	380	W
Plate Output Power	11.9	kW

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

MOUNTING - The 3CX10,000A7 must be operated vertically base up or down. The tube must be protected from severe vibration and shock.

COOLING - The maximum temperature rating for the external surfaces of the 3CX10,000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic/metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate ** Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop(Inches of Water)	Air Flow (CFM)	Pressure Drop(Inches of Water)
4000	105	.24	154	.35
6000	178	.50	275	.80
8000	253	.90	370	1.45
10,000	345	1.4	500	2.30
12,000	483	2.25	710	3.40

** Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1250 watts dissipation.

INPUT CIRCUIT - When the 3CX10,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two of more.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3CX10,000A7 may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier.

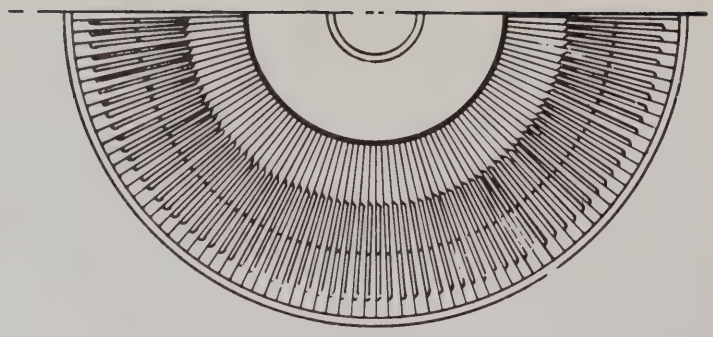
FILAMENT OPERATION - The rated filament voltage for the 3CX10,000A7 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 3CX10,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

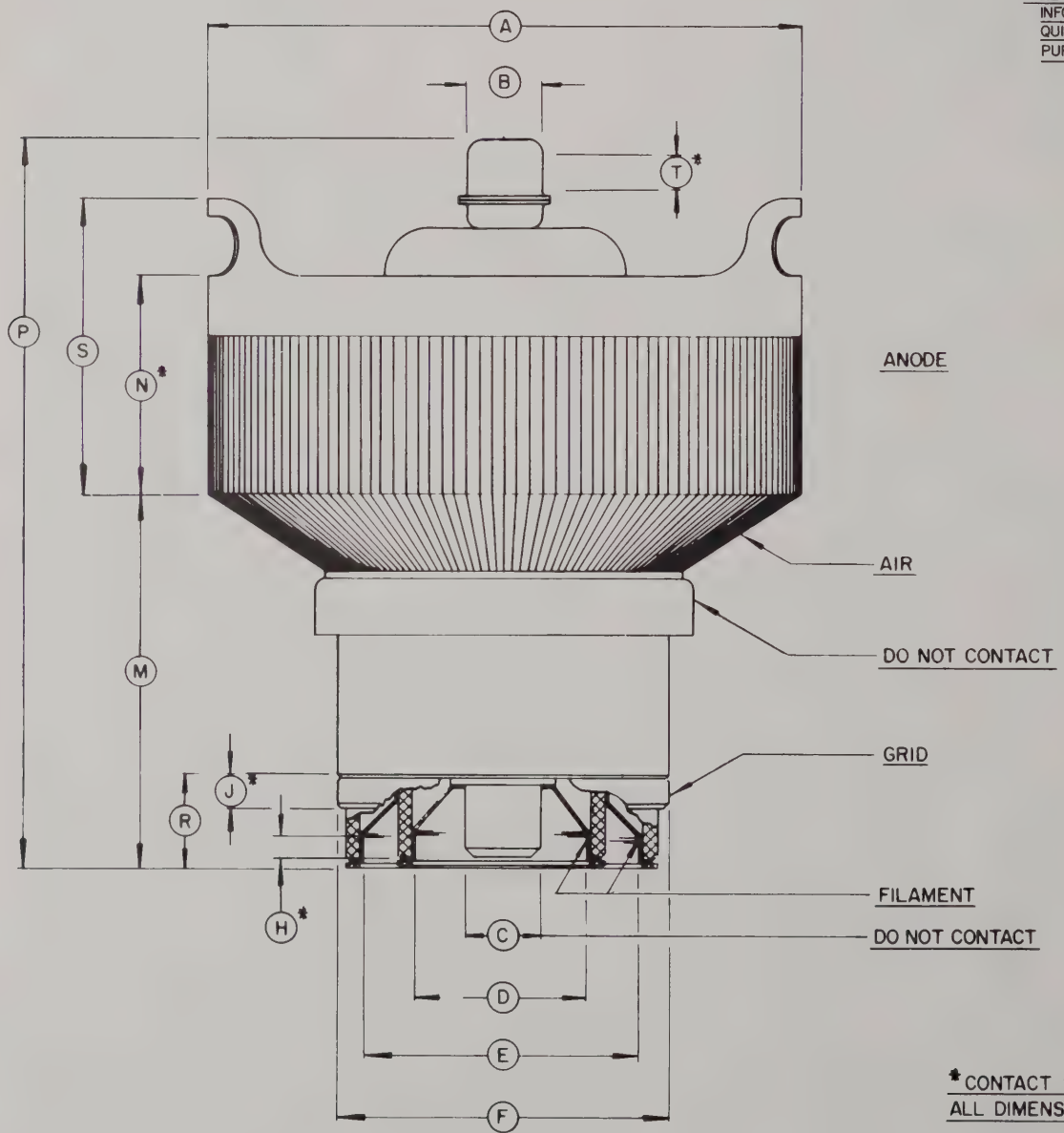
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid **Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070, for information and recommendations.**



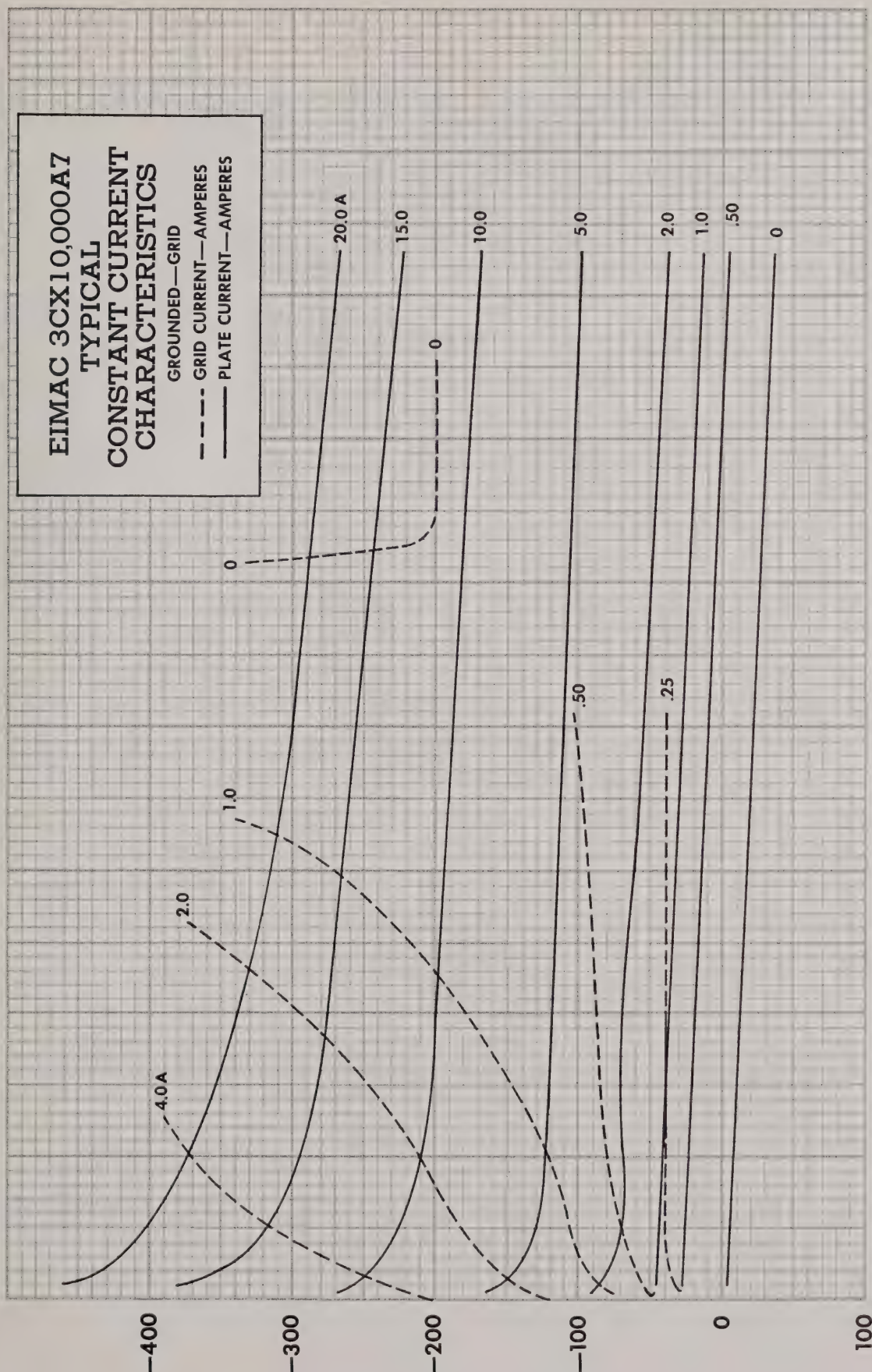
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.928	7.050	- -	175.97	179.07	- -
B	0.855	0.895	- -	21.72	25.49	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	3.950	4.300	- -	100.33	109.22	- -
N	2.412	2.788	- -	61.26	70.81	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.21	- -
T	0.375	- -	- -	9.52	- -	- -

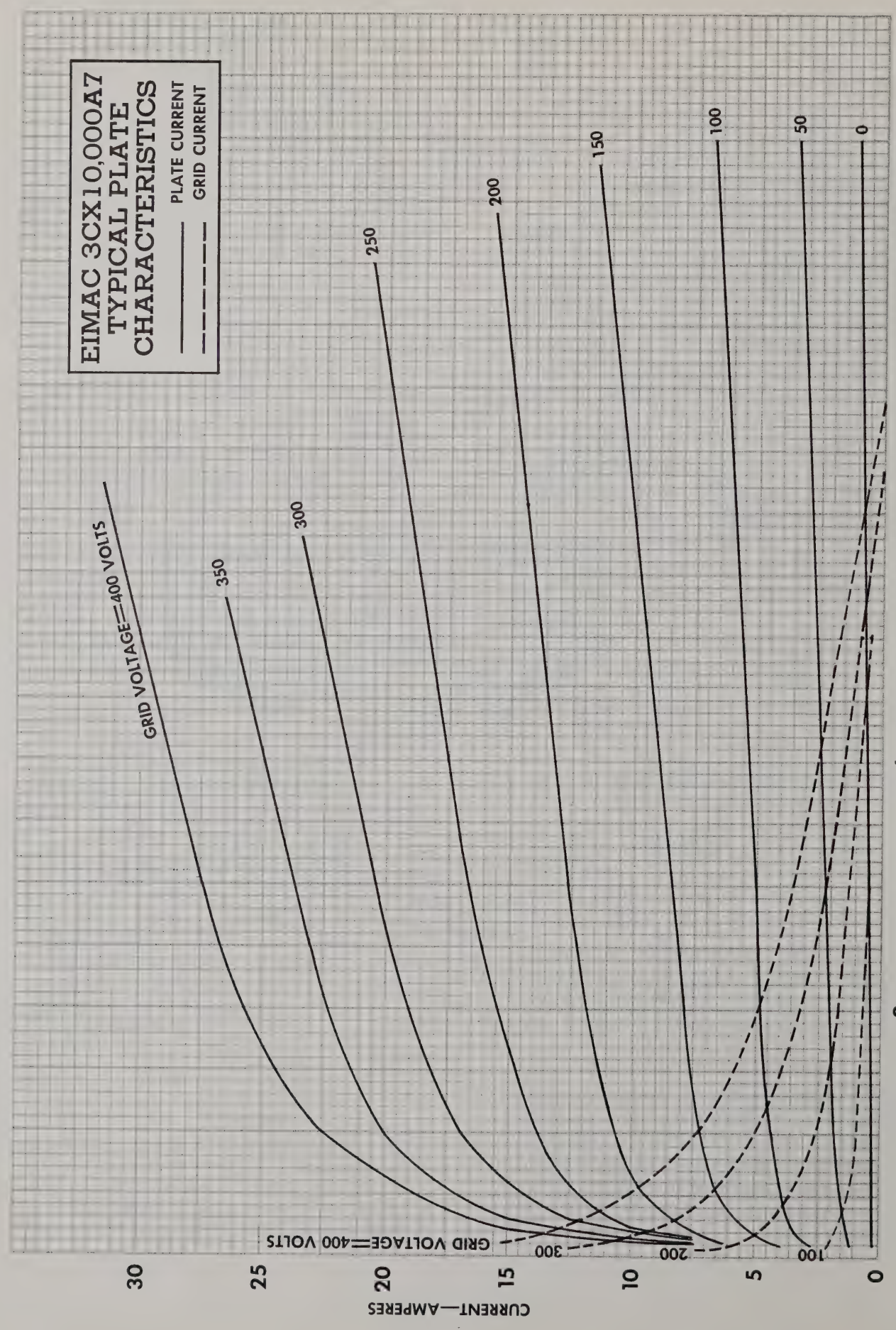
NOTES:

1. REF: DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
20.0 A
15.0
10.0
5.0
2.0
1.0
.50
0
4.0 A
2.0
1.0
0
.50
.25
FILAMENT-TO-GRID VOLTAGE—VOLTS
−400
−300
−200
−100
0
100
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE—KILOVOLTS


EIMAC 3CX10,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE=400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE=400 VOLTS
300
200
100
CURRENT—AMPERES
30
25
20
15
10
5
0
2
4
6
8
PLATE VOLTAGE—KILOVOLTS

volume
2

general

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

TABLE OF CONTENTS

7-1-73

(Effective 7-1-73) © 1973 Varian Associates Printed in U.S.A.

TABLE OF CONTENTS

GENERAL

Tube Type Numbering System 6-1-73
Table of Contents 7-1-73
Index 7-1-73
EIMAC and JEDEC Power Grid Tube Number Cross Reference Sheet 7-1-73
Power Grid Selection Guide 7-1-73
Varian/Eimac Electron Tube and Device Group Sales Offices 7-1-73
Distributor Directory

DIODES - RECTIFIERS

2-01C 1-22-60
2-240A 10-21-59
2-450A 3-1-66
2-2000A 7-1-52
250R 12-15-65
253 7-1-52
575A & 673 4-1-67
869B & 869BL 3-16-64
6894 & 6895 3-16-64
8020 6-1-67

PLANAR TRIODES

2C39A . . . . . see 7289
3CX100A5 . . . . . see 7289
7211/7698 11-15-70
7289/3CX100A5 11-1-71
7698 . . . . . see 7211
7815/7815R 12-1-71
7815AL/7815RAL 7-1-70
7815R . . . . . see 7815
7815RAL . . . . . see 7815AL
7855/7855K 8-1-71
7855AL/7855KAL 3-1-72
7855K . . . . . see 7855
7855KAL . . . . . see 7855AL
8403 12-1-71
8533 12-1-71
8755/8755A 6-1-71
8755A . . . . . see 8755
8757 3-30-70
8847/8847A 6-1-70
8847A . . . . . see 8847
8892 9-1-70
8893 6-1-70
8906/8907 11-1-71
8906AL/Y572AL 11-1-71
8907 . . . . . see 8906
8911 2-1-71
8912 2-1-71
8933 12-14-72
Y572AL . . . . . see 8906AL

TRIODES

3-400Z/8163 5-1-68
3-500Z 2-1-71
3-1000Z/8164 3-15-67
3C24 11-1-51
3CV1500A7 6-15-71
3CV30,000A3 3-1-67
3CV30,000H3 5-1-68
3CW5000A1/8240 & 3CW5000F1/8241 5-15-71
3CW5000A3/8242 6-1-67
3CW5000H3 4-1-66
3CW10,000H3 10-15-70
3CW20,000A1 6-1-67
3CW20,000A3 6-1-66
3CW20,000A7 1-1-63
3CW20,000H3 2-1-65
3CW25,000A3 3-1-67
3CW30,000H3 11-1-68
3CW40,000H3 8-1-67
3CX1000A7/8283 11-1-68
3CX1500A7/8877 5-15-71
3CX2500A3/8161 3-1-67
3CX2500F3/8251 3-1-67
3CX2500H3 2-1-71
3CX3000A1/8238 11-1-67
3CX3000A7 11-20-70
3CX3000F1/8239 11-1-67
3CX3000F7/8162 5-7-70
3CX5000H3 4-1-66
3CX10,000A1/8158 11-15-68
3CX10,000A3/8159 5-1-68
3CX10,000A7/8160 2-1-73
3CX10,000H3 3-15-66
3CX15,000A3 7-1-69
3CX15,000A7 4-15-71
3CX15,000H3 4-1-66
3CX20,000A3 4-15-71
3CX20,000A7 7-1-73
3CX20,000H3 5-1-71
3W5000F3/8243 10-20-61
35T 2-1-69
35TG 6-1-67
75TH 12-15-65
75TL 4-1-67
100TH 4-1-67
100TL 5-1-52
152TH 11-25-52
152TL 4-1-67
250TH 6-15-66
250TL 1-1-61
304TH 4-1-67
304TL 6-1-67
450TH 12-15-65
450TL 12-15-65
592/3-200A3 6-15-66
1000T 12-15-65
1500T 5-5-70

TRIODES

2000T 10-15-50
5867A 11-15-64
6696A 10-15-64
6697A 10-15-64
7480 11-1-68
8873/8874/8875 6-1-71
8874 . . . . . see 8873
8875 . . . . . see 8873
8933 12-14-72
8938 5-15-73

TETRODES

4-65A/8165 5-1-62
4-125A/4D21 6-1-67
4-250A/5D22 5-5-70
4-400A/8438 7-20-70
4-400C/6775 4-1-71
4-500A 3-10-72
4-1000A/8166 10-30-66
4CN15A 6-1-68
4CPX250K/8590 4-1-70
4CS250R 9-1-70
4CV8000A 3-15-71
4CV20,000A 6-1-68
4CV35,000A 5-15-68
4CV50,000E 5-1-70
4CV50,000J 7-15-71
4CV75,000A 6-15-71
4CV100,000C/8351 2-1-68
4CV250,000A 3-1-72
4CW800B/F 3-1-68
4CW2000A/8244 6-15-71
4CW10,000A/8661 4-15-63
4CW25,000A 2-1-72
4CW50,000E 7-1-70
4CW50,000J 7-15-71
4CW100,000D 7-1-67
4CW100,000E 9-1-70
4CW250,000A 3-1-71
4CX125C/F 6-1-67
4CX250B/7203 & 4CX250F/7204 5-15-73
4CX250K/8245 & 4CX250M/8246 5-1-68
4CX250R/7580W 6-16-61
4CX300A/8167 8-30-66
4CX300Y/8561 6-15-66
4CX350A/8321 & 4CX350F/8322 6-15-65
4CX350FJ/8904 9-1-71
4CX600B & 4CX600F 3-20-70
4CX600J/8809 & 4CX600JA/8921 8-15-71
4CX1000A/6168 5-1-70
4CX1000K/8352 8-20-66
4CX1500A 12-1-71
4CX1500B/8660 6-1-67
4CX3000A/8169 5-1-67
4CX5000A/8170 4-15-69
4CX5000J/8909 10-1-71
4CX5000R/8170W 4-15-71
4CX10,000D/8171 1-1-72
4CX10,000J 2-1-72
4CX15,000A/8281 5-15-71
4CX15,000J/8910 10-15-71
4CX35,000C/8349 12-1-70
4W300B/8249 5-1-70
4W20,000A/8173 4-15-64
4X150A/7034 & 4X150D/7035 5-4-70
4X150G/8172 6-15-66
4X500A 1-1-64
6816,6884,7843 11-15-71
6884 . . . . . see 6816
7843 . . . . . see 6816
8560A 7-15-71
8876 6-15-71

PENTODES

5-125B/4E27A 8-15-52
5-500A 5-1-68
5CX1500A 6-6-70
5CX3000A 8-1-67
264/8576 6-5-70
290 5-5-70
8295A 1-15-73

PULSE MODULATORS

4PR60C/8252W 6-30-71
4PR65A/8187 2-15-63
4PR125A/8247 3-15-64
4PR250C/8248 9-1-70
4PR400A/8188 9-15-65
4PR1000A/8189 12-15-65
6C21 12-15-65

OTHER PRODUCTS

VS-2, 4, 5 & 6 4-4-70
Preformed Contact Finger Stock 6-15-71
HR Heat Dissipating Connectors 12-1-65
SK-300A 4-15-69
SK-306, SK-316 8-15-66
SK-400 4-1-56
SK-406, SK-416, SK-426 6-1-67
SK-410 11-15-62
SK-500 3-15-67
SK-506, SK-516 4-15-69
SK-510 6-15-71
SK-600A, SK-610A 6-15-71
SK-606, SK-626, SK-636B 8-15-66
SK-607 8-15-71

OTHER PRODUCTS

SK-620, SK-620A 3-15-67
SK-630, SK-630A 3-15-67
SK-640 2-15-66
SK-650, SK-655 1-15-66
SK-700, SK-710 10-15-66
SK-711A, SK-712A 3-15-71
SK-740 8-15-66
SK-760, SK-770 7-27-70
SK-800B, SK-806 4-9-64
SK-810B, SK-806 6-1-67
SK-860, SK-870 3-15-67
SK-890B, SK-806 6-1-67
SK-900, SK-906 8-15-66
SK-1300, SK-1310, SK-1320 3-1-72
SK-1306, SK-1406 8-15-66
SK-1400A, SK-1470A 10-15-66
SK-2200, SK-2210 8-15-72

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California
94070

INDEX

7-1-73

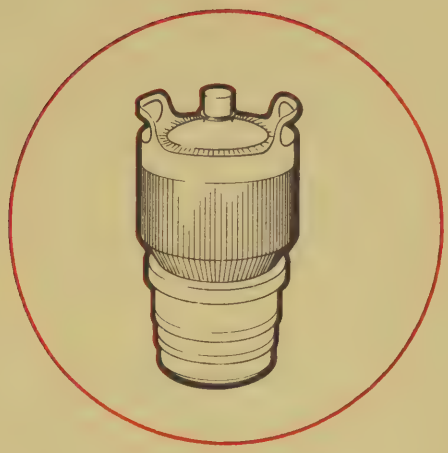
Printed in U.S.A.

100TH	T	3CX10,000A3/8159	T	4CX600J/8809	TET
100TL	T	3CX10,000A7/8160	T	4CX600JA/8921	
152TH	T	3CX10,000H3	T	see 4CX600J	TET
152TL	T	3CX15,000A3	T	4CX1000A/8168	TET
1000T	T	3CX15,000A7	T	4CX1000K/8352	TET
1500T	T	3CX15,000H3	T	4CX1500A	TET
250R	R	3CX20,000A3	T	4CX1500B/8660	TET
250TH	T	3CX20,000A7	T	4CX3000A/8169	TET
250TL	T	3CX20,000H3	T	4CX5000A/8170	TET
253	R	3W5000F3/8243	T	4CX5000J/8909	TET
264/8576	PE	450TH	T	4CX5000R/8170W	TET
290	PE	450TL	T	4CX10,000D/8171	TET
2000T	T	4-65A/8165	TET	4CX10,000J	TET
2-01C	D	4-125A/4D21	TET	4CX15,000A/8281	TET
2-240A	R	4-250A/5D22	TET	4CX15,000J/8910	TET
2-450A	R	4-400A/8438	TET	4CX35,000C/8349	TET
2-2000A	R	4-400C/6775	TET	4D21 see 4-125A	TET
2C39A see 7289	PL	4-500A	TET	4E27A see 5-125B	PE
35T	T	4-1000A/8166	TET	4PR60C/8252W	PM
35TG	T	4CN15A	TET	4PR65A/8187	PM
304TH	T	4CPX250K/8590	TET	4PR125A/8247	PM
304TL	T	4CS250R	TET	4PR250C/8248	PM
3-200A3 see 592	T	4CV800A	TET	4PR400A/8188	PM
3-400Z/8163	T	4CV20,000A	TET	4PR1000A/8189	PM
3-500Z	T	4CV35,000A	TET	4W300B/8249	TET
3-1000Z/8164	T	4CV50,000E	TET	4W20,000A/8173	TET
3C24	T	4CV50,000J	TET	4X150A/7034	TET
3CV1500A7	T	4CV75,000A	TET	4X150D/7035	TET
3CV30,000A3	T	4CV100,000C/8351	TET	4X150G/8172	TET
3CV30,000H3	T	4CV250,000A	TET	4X500A	TET
3CW5000A1/8240	T	4CW800B	TET	575A	R
3CW5000A3/8242	T	4CW800F see 4CW800B	TET	592/3-200A3	T
3CW5000F1/8241	T	4CW2000A/8244	TET	5867A	T
3CW5000H3	T	4CW10,000A	TET	5-125B/4E27A	PE
3CW10,000H3	T	4CW25,000A	TET	5-500A	PE
3CW20,000A1	T	4CW50,000E	TET	5CX1500A	PE
3CW20,000A3	T	4CW50,000J	TET	5CX3000A	PE
3CW20,000A7	T	4CW100,000D	TET	5D22 see 4-250A	TET
3CW20,000H3	T	4CW100,000E	TET	673 see 575A	R
3CW25,000A3	T	4CW250,000A	TET	6696A	T
3CW30,000H3	T	4CX125C	TET	6697A	T
3CW40,000H3	T	4CX125F see 4CX125C	TET	6775 see 4-400C	TET
3CX100A5 see 7289	PL	4CX250B/7203	TET	6816	TET
3CX1000A7/8283	T	4CX250F/7204	TET	6884 see 6816	TET
3CX1500A7/8877	T	4CX250K/8245	TET	6894	R
3CX2500A3/8161	T	4CX250M/8246	TET	6895 see 6894	R
3CX2500F3/8251	T	4CX250R/7580W	TET	6C21	PM
3CX2500H3	T	4CX300A/8167	TET	75TH	T
3CX3000A1/8238	T	4CX300Y/8561	TET	75TL	T
3CX3000A7	T	4CX350A/8321	TET	750TL	T
3CX3000F1/8239	T	4CX350F/8322	TET	7034 see 4X150A	TET
3CX3000F7/8162	T	4CX350FJ/8904	TET	7035 see 4X150A/D	TET
3CX5000H3	T	4CX600B	TET	7203 see 4CX250B	TET
3CX10,000A1/8158	T	4CX600F see 4CX600B	TET	7204 see 4CX250B/F	TET

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

7211	PL
7289/3CX100A5	PL
7480	T
7580W see 4CX250R	TET
7698	PL
7815/7815R	PL
7815AL/7815RAL	PL
7815R see 7815	PL
7815RAL see 7815AL	PL
7843	TET
7855/7855K	PL
7855AL/7855KAL	PL
7855K see 7855	PL
7855KAL see 7855AL	PL
869B	R
869BL see 869B	R
8020	R
8158 see 3CX10,000A1	T
8159 see 3CX10,000A3	T
8160 see 3CX10,000A7	T
8161 see 3CX2500A3	T
8162 see 3CX3000F7	T
8163 see 3-400Z	T
8164 see 3-1000Z	T
8165 see 4-65A	TET
8166 see 4-1000A	TET
8167 see 4CX300A	TET
8168 see 4CX1000A	TET
8169 see 4CX3000A	TET
8170 see 4CX5000A	TET
8170W see 4CX5000R	TET
8171 see 4CX10,000D	TET
8172 see 4X150G	TET
8173 see 4W20,000A	TET
8187 see 4PR65A	PM
8188 see 4PR400A	PM
8189 see 4PR1000A	PM
8238 see 3CX3000A1	T
8239 see 3CX3000F1	T
8240 see 3CW5000A1	T
8241 see 3CW5000A1/F1	T
8242 see 3CW5000A3	T
8244 see 4CW2000A	TET
8245 see 4CX250K	TET
8246 see 4CX250K/M	TET
8247 see 4PR125A	PM
8248 see 4PR250C	PM
8249 see 4W300B	TET
8251 see 3CX2500F3	T
8252W see 4PR60C	PM
8281 see 4CX15,000A	TET
8283 see 3CX1000A7	T
8295A	PE
8321 see 4CX350A	TET
8322 see 4CX350A/F	TET
8349 see 4CX35,000C	TET
8351 see 4CV100,000C	TET
8352 see 4CX1000K	TET
8403	PL
8438 see 4-400A	TET
8533	PL
8560A	TET
8561 see 4CX300Y	TET
8576 see 264	PE
8590 see 4CPX250K	TET
8660 see 4CX1500B	TET
8661 see 4CW10,000A	TET
8755	PL
8755A see 8755	PL
8757	PL
8809 see 4CX600J	TET
8847	PL
8847A see 8847	PL
8873	T
8874 see 8873	T
8875 see 8873	T
8876	TET
8877 see 3CX1500A7	T
8892	PL
8893	PL
8904 see 4CX350FJ	TET
8906	PL
8906AL/Y572AL	PL
8907 see 8906	PL
8909 see 4CX5000J	TET
8910 see 4CX15,000J	TET
8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8933	PL
8938	T
Contact Finger Stock (Preformed)	OP
HR Heat Dissipating Connectors	OP
SK-300A	OP
SK-306	OP
SK-316 see SK-306	OP
SK-400	OP
SK-406	OP
SK-410	OP
SK-416 see SK-406	OP
SK-426 see SK-406	OP
SK-500	OP
SK-506	OP
SK-510	OP
SK-516 see SK-506	OP
SK-600A	OP
SK-606	OP
SK-607	OP
SK-610 see SK-600A	OP
SK-620	OP
SK-620A see SK-620	OP
SK-626 see SK-606	OP
SK-630	OP
SK-630A see SK-630	OP
SK-636B see SK-606	OP
SK-640	OP
SK-650	OP
SK-655 see SK-650	OP
SK-700	OP
SK-710 see SK-700	OP
SK-711A	OP
SK-712A see SK-711A	OP
SK-740	OP
SK-760	OP
SK-770 see SK-760	OP
SK-800B	OP
SK-806 see SK-800B	OP
SK-810B	OP
SK-860	OP
SK-870 see SK-860	OP
SK-890B	OP
SK-900	OP
SK-906 see SK-900	OP
SK-1300	OP
SK-1306	OP
SK-1310 see SK-1300	OP
SK-1320 see SK-1300	OP
SK-1400A	OP
SK-1406 see SK-1306	OP
SK-1470A see SK-1400A	OP
SK-2200	OP
SK-2210 see SK-2200	OP
VS-2, 4, 5 & 6	OP
Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode



tetrodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

4CV250,000A

TECHNICAL DATA

VAPOR COOLED
POWER TETRODE

The EIMAC 4CV250,000A is a ceramic/metal, vapor-cooled power tetrode intended for use at the 250 to 500 kilowatt output power level. It is recommended for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier or a Class AB push-pull af amplifier or modulator. The 4CV250,000A is also useful as a plate and screen modulated Class C rf amplifier.

The vapor cooled anode is rated at 250 kilowatts maximum dissipation when used with the EIMAC Y-585 boiler.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	12.0 ± 0.6	V
Current (at 12.0 volts)	660	A
Amplification Factor (Grid-Screen)(Avg.)	4.5	
Direct Interelectrode Capacitance: (Grounded Cathode)[2]		
Cin	765	pF
Cout	124	pF
Cgp	6.0	pF
Frequency for Maximum Ratings	30	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured without any special shielded fixture.

MECHANICAL

Base	Special
Maximum Seal Temperature	200° C
Recommended Boiler	EIMAC Y-585
Operating Position	Vertical, Anode up
Maximum Dimensions:	
Height	28.02 in; 71.17 cm
Diameter	15.062 in; 38.26 cm
Cooling	Vapor and water
Net Weight	180 lb.; 82 kg
Shipping Weight (approximate)	350 lb.; 159 kg

(Revised 3-1-72) © 1972 Varian Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-down Condition)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	16	19	kV
DC Screen Voltage	800	800	V
DC Grid Voltage	-800	-800	V
DC Plate Current	23.5	32.5	A
DC Screen Current	2.4	3.5	A
DC Grid Current	1.15	2.5	A
Driving Power [1]	2.24	3.0	kW
Plate Output Power	275	460	kW
Plate Dissipation	100	155	kW
RF Load Impedance	300	275	Ω

1. Calculated Driving Power neglects input conductance and rf circuit loss.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class C Telephony (Carrier conditions except where noted)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,000	VOLTS
DC PLATE CURRENT	30	AMPERES
PLATE DISSIPATION [1]	167,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Corresponds to 250,000 watts at 100 per cent sine wave modulation.
2. Approximate Value.

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	15	kV
DC Screen Voltage	800	V
Peak af Screen Voltage(for 100% Mod.)2.	800	V
DC Grid Voltage	-800	V
DC Plate Current	22.8	A
DC Screen Current	4.1	A
DC Grid Current	1.46	A
Peak rf Grid Voltage	1110	v
Grid Driving Power [3]	1630	W
Plate Output Power	280	kW
RF Load Impedance	323	Ω
Plate Dissipation	63	kW

3. Calculated Driving Power neglects input conductance and rf circuit loss.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Approximate Value.
2. Per Tube

TYPICAL OPERATION (Two Tubes Class AB_1)

DC Plate Voltage	15	20	kV
DC Screen Voltage	1.8	1.8	kV
DC Grid Voltage	-500	-500	V
Max-Signal Plate Current	40	46	A
Zero Signal Plate Current[2]	0.2	0.2	A
Max-Signal Screen Current [1]	1.1	1.2	A
Peak af Driving Voltage 2.	500	500	v
Driving Power	0	0	W
Load Impedance (plate to plate)	650	870	Ω
Plate Dissipation	160	260	kW
Max-Signal Output Power	440	660	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Approximate Value.
2. Calculated Driving Power neglects input conductance and rf circuit loss.

TYPICAL OPERATION Class AB_1 Peak-Envelope or Modulation Crest Conditions (Frequencies below 30 MHz)

DC Plate Voltage	15	20	kV
DC Screen Voltage	1.8	1.8	kV
DC Grid Voltage	-500	-500	V
Plate Current	20	23	A
Zero Signal Plate Current	0.2	0.2	A
Maximum Signal Screen Current 1.	1.1	1.2	A
Peak rf Grid Voltage	500	500	v
Driving Power 2.	0	0	W
Plate Dissipation	80	130	kW
Resonant Load Impedance	325	435	Ω
Plate Output Power	220	330	kW

PULSE MODULATOR OR REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	40,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
PEAK CATHODE CURRENT	350 AMPERES
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

APPLICATION

MECHANICAL

MOUNTING - The 4CV250,000A must be mounted vertically, anode up. The tube may be supported by the anode flange or the screen flange.

Care must be exercised to insure that the axis of the tube/boiler combination is vertical and that water in the boiler is at the level indicated. The anode flange on the tube must seat securely against the rubber "O" ring, forming a vapor-tight seal between tube and boiler.

COOLING - Cooling is accomplished by immersing the anode of the 4CV250,000A in a "Boiler" filled with distilled water. Energy dissipated by the anode causes the water to boil at the anode surfaces, be converted into steam and be carried away to an external condenser. The condensate is then returned to the boiler, completing the cycle.

This boiling action maintains the anode surfaces at a fairly constant temperature near 100°C. The vapor-cooled tube has good overload capabilities; excess dissipation for moderate periods only causes more water to boil.

Since the tube anode and boiler are usually at high potential to ground, water and steam connections to the boiler are made through insulated tubing.

The filament supports of the 4CV250,000A are water cooled. Approximately .5 GPM should circulate through each of the filament connectors with a pressure drop of 20 PSI. Filament connector assemblies, SK-1710, provide electrical and water connections. Two sets of SK-1710 are required.

It is recommended that the water cooled control grid connector, SK-1712, be used. Water flow of approximately .5 GPM should circulate through the grid connector. The pressure drop across the grid connector is low. A convenient way to make water connection is to series connect the grid cooling water with the outer filament cooling water path.

The outer filament water path has a lower pressure drop than the inner filament water path making this connection practical.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CV-250,000A is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CV250,000A by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked.

Filament starting current must be limited to a maximum of 1800 amperes.

CONTROL GRID OPERATION - The 4CV-250,000A control grid is rated at 1,500 watts of dissipation and protective measures should be included in circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of dc grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power applied to the screen grid must not exceed 3,500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of RMS screen current and RMS screen voltage.

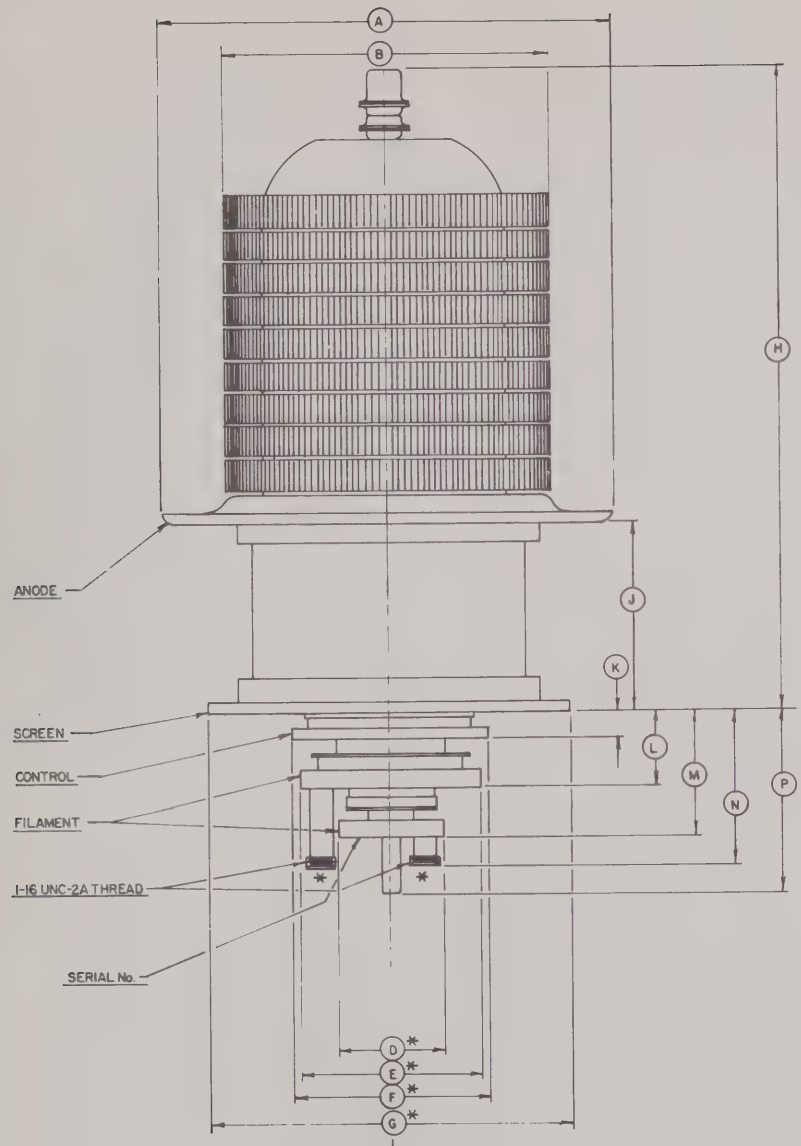
PLATE DISSIPATION - The plate dissipation of 250 kilowatts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV250,000A is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 167,000 watts.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV250,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

HIGH VOLTAGE - Normal operating voltages used with the 4CV250,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

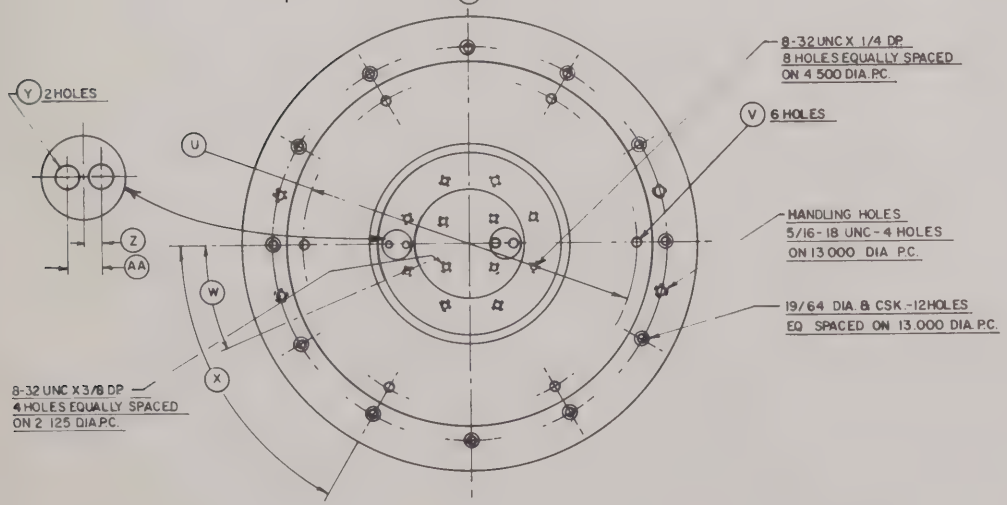


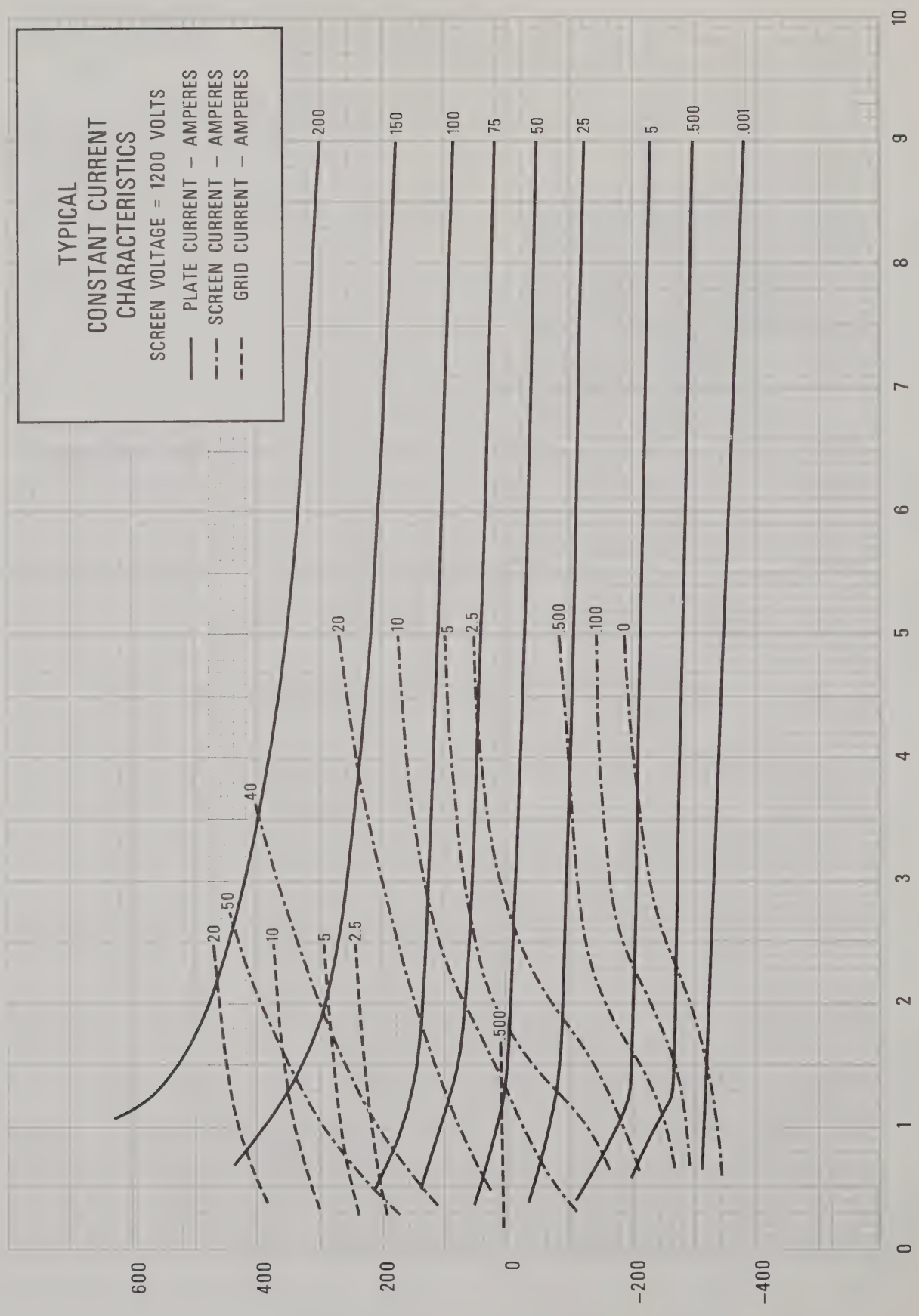
DIMENSIONAL DATA

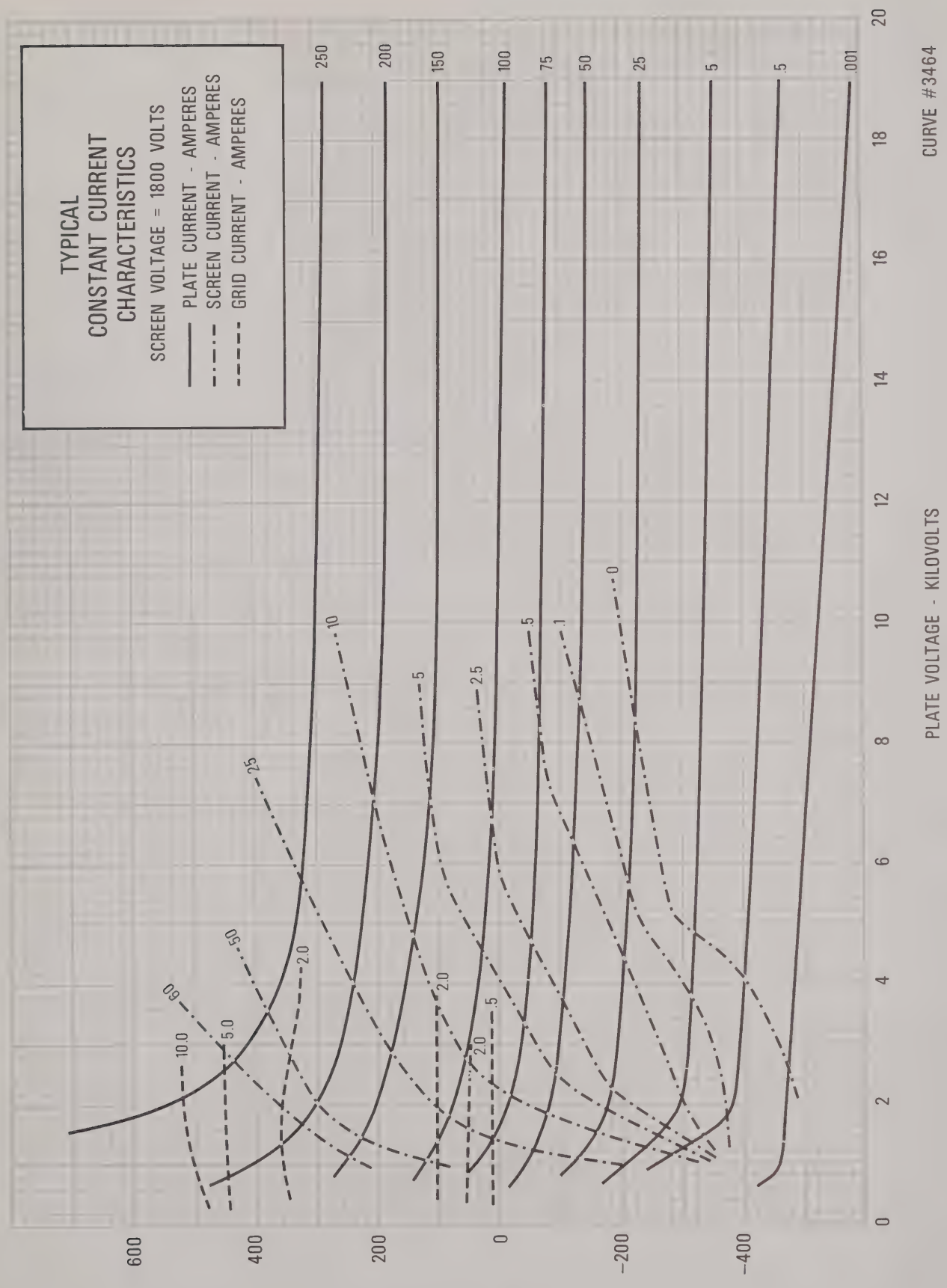
DIM	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	14.937	15.062	- -	379.40	382.57	- -
B	12.5	1.375	- -	282.57	288.92	- -
D	3.437	3.562	- -	87.30	90.47	- -
E	5.937	6.062	- -	150.80	153.97	- -
F	6.437	6.562	- -	163.50	166.67	- -
G	11.937	12.062	- -	303.20	306.37	- -
H	20.400	21.120	- -	518.16	536.45	- -
J	6.250	6.375	- -	158.75	161.92	- -
K	0.750	0.875	- -	19.05	22.22	- -
L	2.437	2.562	- -	61.90	65.07	- -
M	4.062	4.187	- -	103.17	106.35	- -
N	5.000	5.125	- -	127.00	130.17	- -
U	- -	- -	11.000	- -	- -	279.40
V	- -	- -	0.375	- -	- -	9.52
W	- -	- -	22-1/2°	- -	- -	22-1/2°
X	- -	- -	60°	- -	- -	60°
Y	- -	- -	0.261	- -	- -	6.63
Z	- -	- -	0.219	- -	- -	5.56
AA	- -	- -	0.438	- -	- -	11.12

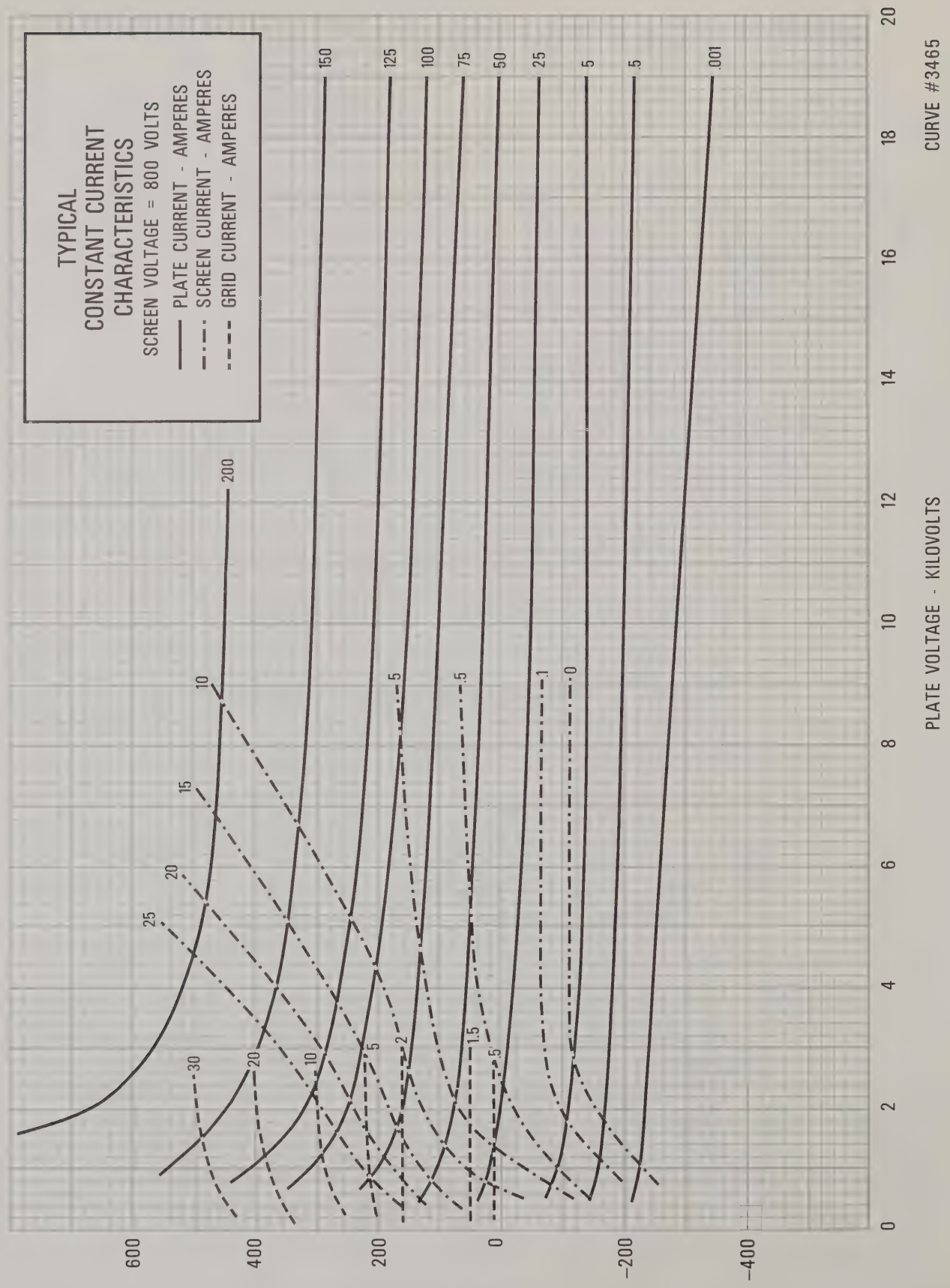
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

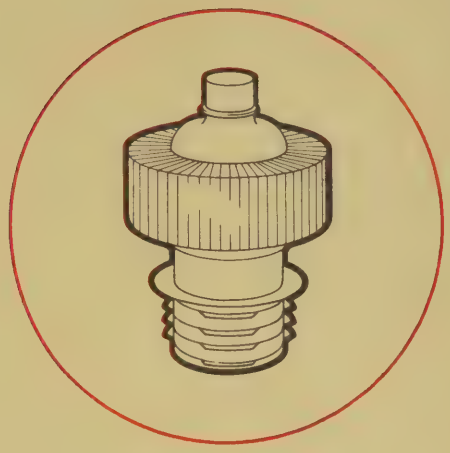
2. (*) CONTACT SURFACES.




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1200 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
200
150
100
75
50
25
5
.500
.001
40
20
10
5
2.5
.500
20
10
5
2.5
.500
100
0
600
400
200
0
–200
–400
0
1
2
3
4
5
6
7
8
9
10
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
CURVE #3285


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
250
200
150
100
75
50
25
5
.5
.001
10
25
50
60
10.0
5.0
2.0
5
2.5
.5
.1
0
600
400
200
0
−200
−400
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS
CURVE #3464


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
150
125
100
75
50
25
5
.5
.001
200
10
15
20
25
30
20
10
5
2
1.5
.5
5
.5
1
0
600
400
200
0
-200
-400
GRID VOLTAGE - VOLTS
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE - KILOVOLTS
CURVE #3465



pentodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

8295A

RADIAL BEAM
POWER PENTODE

The EIMAC 8295A is a ceramic/metal, forced-air cooled, radial beam pentode with a rated maximum plate dissipation of 1000 watts. It is capable of high power gain and excellent efficiency at relatively low plate voltage. The 8295A is a direct replacement for the 8295.

This external-anode tube is especially suited for Class AB_1 linear rf amplifier service, but will also provide excellent performance in Class AB_2, Class B, and Class C service.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current , at 6.0 volts	8.2 A
Amplification Factor (Average):	
Grid to Screen	3.4
Direct Interelectrode Capacitances (grounded cathode)[2]	
Input	40 pF
Output	18.5 pF
Feedback	0.09 pF
Frequency of Maximum Rating:	
CW	30 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	5.05 in; 128 mm
Diameter	4.03 in; 102 mm
Net Weight	2.8 lb; 1.27 kg
Operating Position	Any

(Revised 1-15-73) © 1970 Varian

Printed in U.S.A.

Maximum Operating Temperature	
Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced Air
Base	7-Pin Special
Recommended Socket (includes integral chimney)	EIMAC SK-184 or EIMAC SK-184A

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000 VOLTS
DC SUPPRESSOR VOLTAGE	100 VOLTS
DC SCREEN VOLTAGE	600 VOLTS
DC PLATE CURRENT	0.8 AMPERE
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	30 WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	2500	3000	Vdc
Suppressor Voltage	35	0	35	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage[1]	-116	-119	-120	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Single Tone Plate Current[4]	800	800	800	mAdc
Zero-Signal Screen Current	5	5	4	mAdc
Single-Tone Screen Current[3/4]	75	43	54	mAdc
Peak rf Grid Voltage[3]	116	119	120	v
Single Tone Useful Output Power	1100	1250	1700	W
Resonant Load Impedance	1400	1500	2100	Ω
Intermodulation Distortion Products[2] - 3rd Order	-24	-22	-23	db
5th Order	-37	-50	-40	db

1. Adjust to specified zero-signal dc plate current.

2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.

3. Approximate value

4. For peak conditions, or for single-tone modulation at full signal. Except for brief tuneup periods, operation under single-tone conditions may not be possible because of excessive screen dissipation.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000 VOLTS
DC SUPPRESSOR VOLTAGE	75 VOLTS
DC SCREEN VOLTAGE	500 VOLTS
DC GRID VOLTAGE	-200 VOLTS
DC PLATE CURRENT	1.0 AMPERE
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	30 WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	2000	2500	3000	Vdc
Suppressor Voltage	35	35	35	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-175	-200	-200	Vdc
Plate Current	850	840	820	mAdc
Screen Current[1]	42	40	42	mAdc
Grid Current[1]	10	10	10	mAdc
Peak rf Grid Voltage[1]	188	210	210	v
Calculated Driving Power[1]	1.9	2.1	2.1	W
Plate Input Power	1700	2100	2460	W
Useful Output Power	1155	1440	1770	W

1. Approximate value.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	7.7	8.7	A
Cathode Warmup Time	3	---	minutes
Interelectrode Capacitances [1] (grounded cathode connection)			
Input	36.0	44.0	pF
Output	16.5	20.5	pF
Feedback	---	0.12	pF
Amplification Factor			
Grid to Screen	3.0	3.8	

1. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING - The 8295A may be operated in any position, and should normally be mounted in the EIMAC air-system socket SK-184 or SK-184A, or equivalent. The SK-184 socket has built-in bypass capacitors for the screen grid and suppressor grid. The SK-184A socket has a built-in bypass capacitor for the screen grid and has grounded suppressor grid contacts.

HEATER - The rated heater voltage for the 8295A is 6.0 volts, as measured at the socket or tube base pins. Variations should be restricted to plus or minus 0.3 volts for long tube life and consistent performance.

COOLING - Forced-air cooling is required in all applications, and the use of an air-system socket, such as the EIMAC SK-184 or EIMAC SK-184A, is recommended. Each of these sockets includes an integral chimney to direct air through the anode cooling fins. Cooling is simplified if air is directed in a base-to-anode direction. At full rated dissipation, with air at 50°C at sea level, an air flow of 25 cubic feet per minute, with a resulting pressure drop of approximately 0.15 inches of water, is sufficient to limit maximum tube temperature to 225°C. If air is not directed in the base-to-anode direction, additional cooling may be required for the base section of the tube. Cooling air should be applied before or simultaneously with the application of electrode voltages, including heater, and may be removed simultaneously with them.

CATHODE WARMUP TIME - Heater voltage should be applied for a minimum of three minutes before the application of other electrode voltages to allow proper conditioning of the cathode surface.

GRID OPERATION - In Class AB applications, grid bias voltage must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 5000 ohms in Class AB_1 applications or 2000 ohms in Class AB_2 applications. Either fixed bias or cathode bias, or a combination of the two, is recommended for Class C applications. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class C application provided the total resistance of the grid leak plus the bias source does not exceed 5000 ohms.

SCREEN OPERATION - If the screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen over-current relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit problems, grid bias failure, or accidental removal of plate circuit loading. In linear amplifier service, the screen voltage must be obtained from a well regulated source, to prevent excessive screen voltage variation due to changes in screen current which occur between zero-signal and full-signal conditions.

SUPPRESSOR OPERATION - The 8295A performs well with the suppressor operated at cathode potential. For maximum efficiency at high power input and low plate voltages, a positive voltage of about 35 volts should be applied to the suppressor. However, the actual value is not critical, and voltages between 25 and 45 volts may be used with only minor differences in performance. The internal resistance of the suppressor grid voltage supply should not exceed 3000 ohms.

PLATE OPERATION - The maximum rated plate dissipation power for the 8295A is 1000 watts. Except for brief periods during circuit adjustment, this maximum value should not be exceeded. Contact to the plate may be made either at the top cap or by means of a circular clamp or spring-finger collet around the outer surface of the anode cooler itself. Points of electrical contact with the anode should be kept clean and free of oxide to minimize rf loss. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

GENERAL OPERATION NOTES - A metal chassis or equivalent means should be provided to separate the input and output circuits of an amplifier employing the 8295A. Reasonable precautions should be observed in regard to bypassing and shielding of the supply leads to prevent coupling between input and output through external circuits. The use of the EIMAC SK-184 or SK-184A air-system sockets, with integral bypass capacitance built in, is helpful in these respects. When it is desired to apply voltage to the suppressor of the tube, it is recommended that any suppressor bypass capacitance be located on the anode side of a chassis. Total suppressor bypass capacitance should be sufficient to result in a reactance of 3 ohms or less at the operating frequency. The dc supply lead to the suppressor should either be located entirely on the anode side of the shielding (chassis), or fed through an effective rf choke located well out of the field of the plate tank circuit and again bypassed before passing through the shielding into any compartment exposed to the control grid circuit.

NEUTRALIZATION FOR RF OPERATION - In most Class C applications, the 8295A may be operated without neutralization provided the suppressor grid and screen grid are effectively grounded for radio frequencies. The use of the EIMAC air-system sockets is helpful in this respect. For minimum-distortion Class AB1 linear amplifier service, where reaction on the driver circuit should be eliminated completely, it will usually be found advisable to neutralize the small feedback capacitance of the tube.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 8295A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

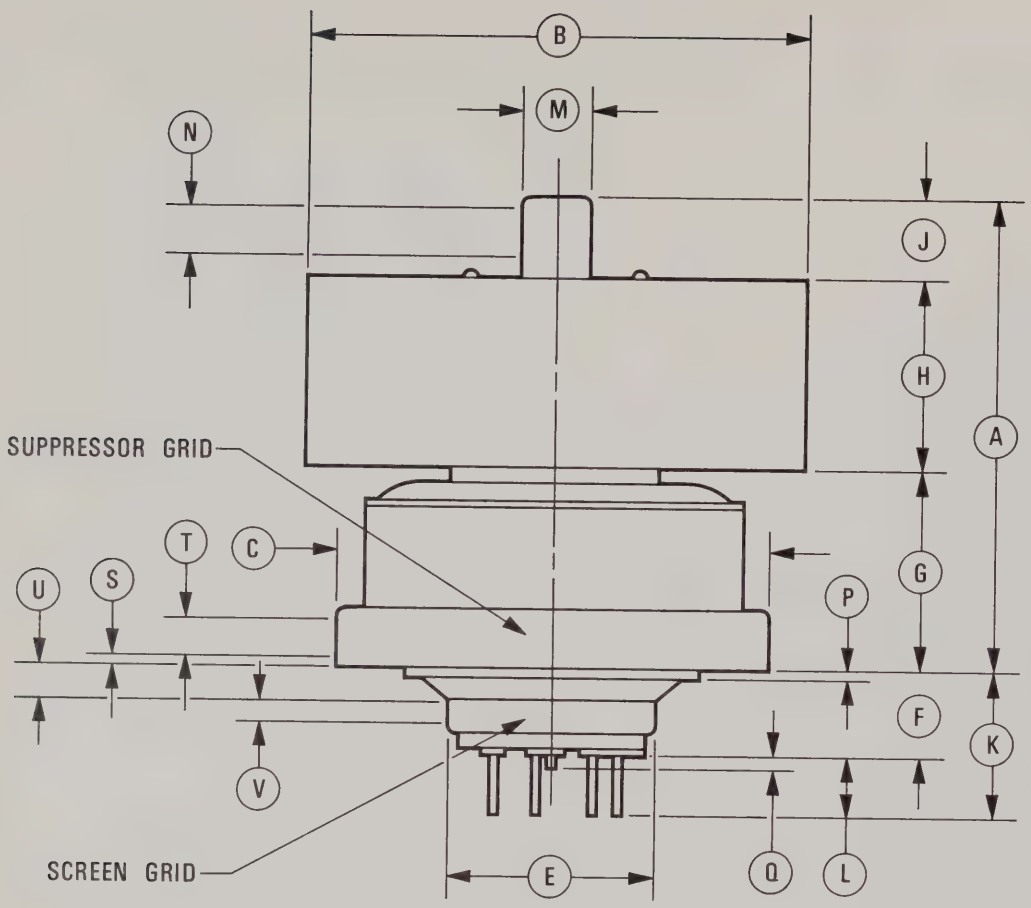
AIR-SYSTEM SOCKETS

Two air-system sockets are available for the 8295A, each of which makes all electrical contacts to the tube except to the anode. The characteristics of these sockets are as follows:

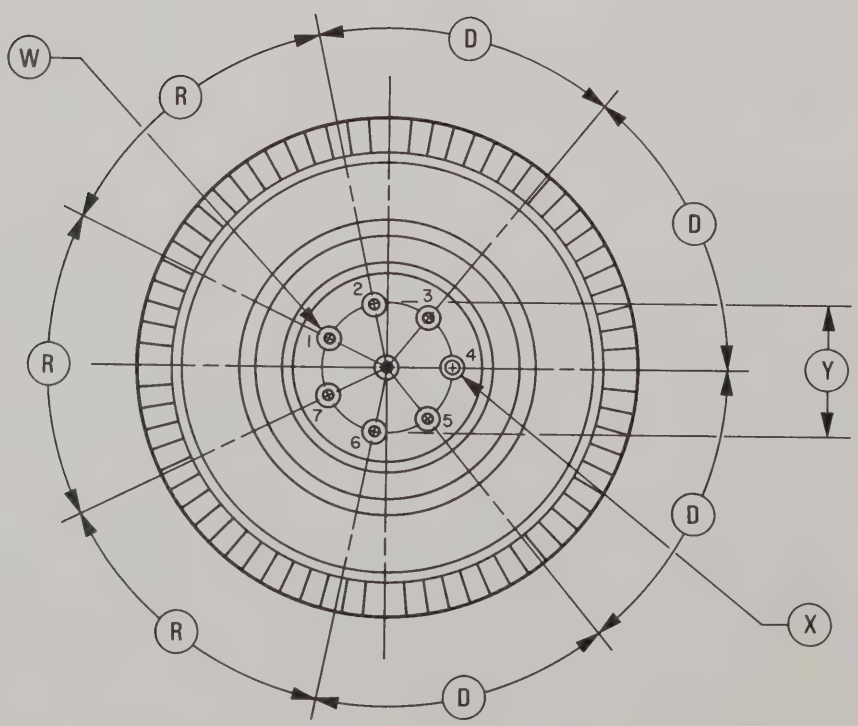
	EIMAC SK-184	EIMAC SK-184A
Screen Grid Bypass Capacitor	2000 pF, 1000 Vdc	2000 pF, 1000 Vdc
Suppressor Grid Bypass Capacitor	2500 pF, 500 Vdc	none
Grounded Contacts (to socket frame)	none	Suppressor Grid
Anode Air Chimney	Integral	Integral

SPECIAL APPLICATION

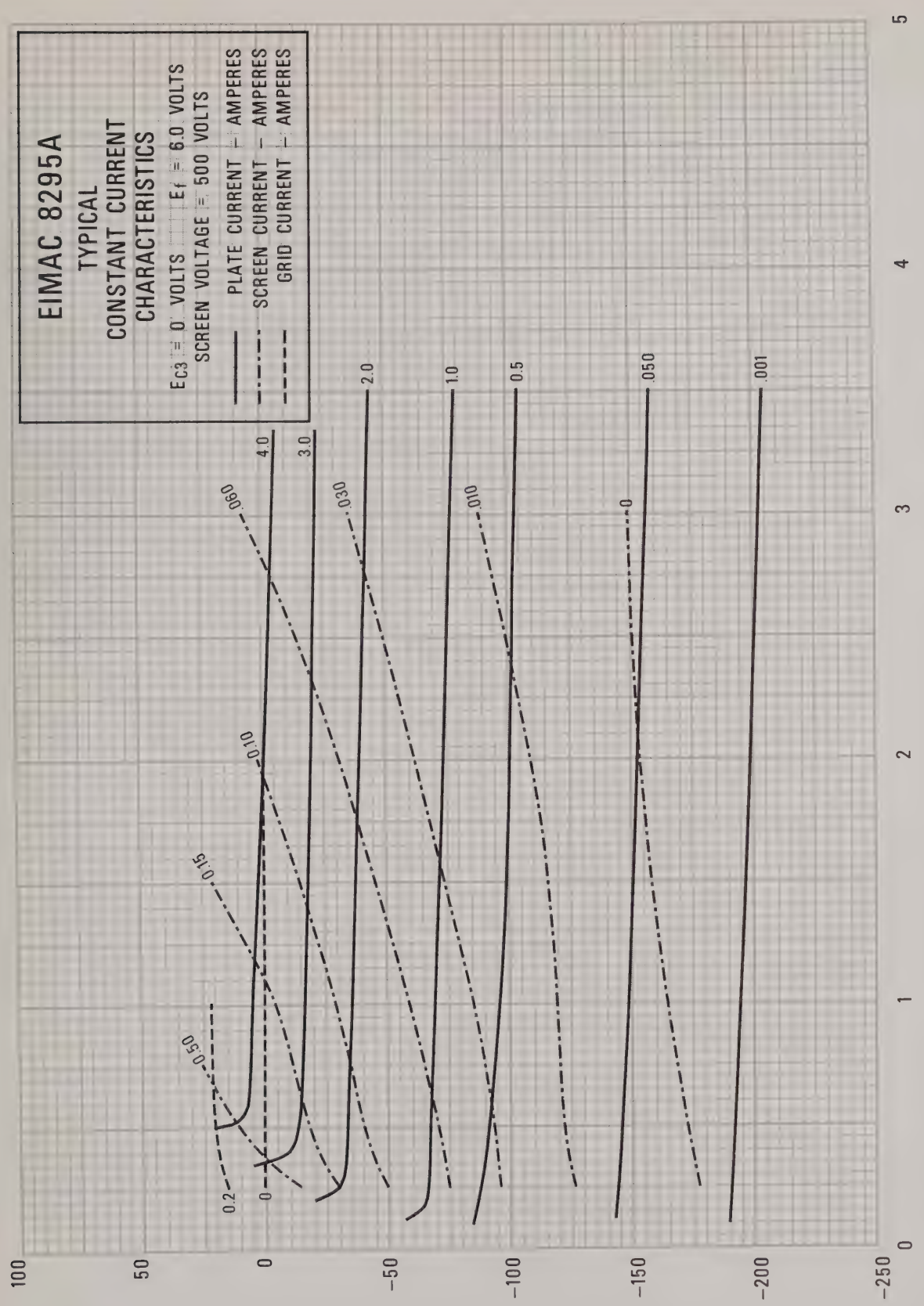
If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

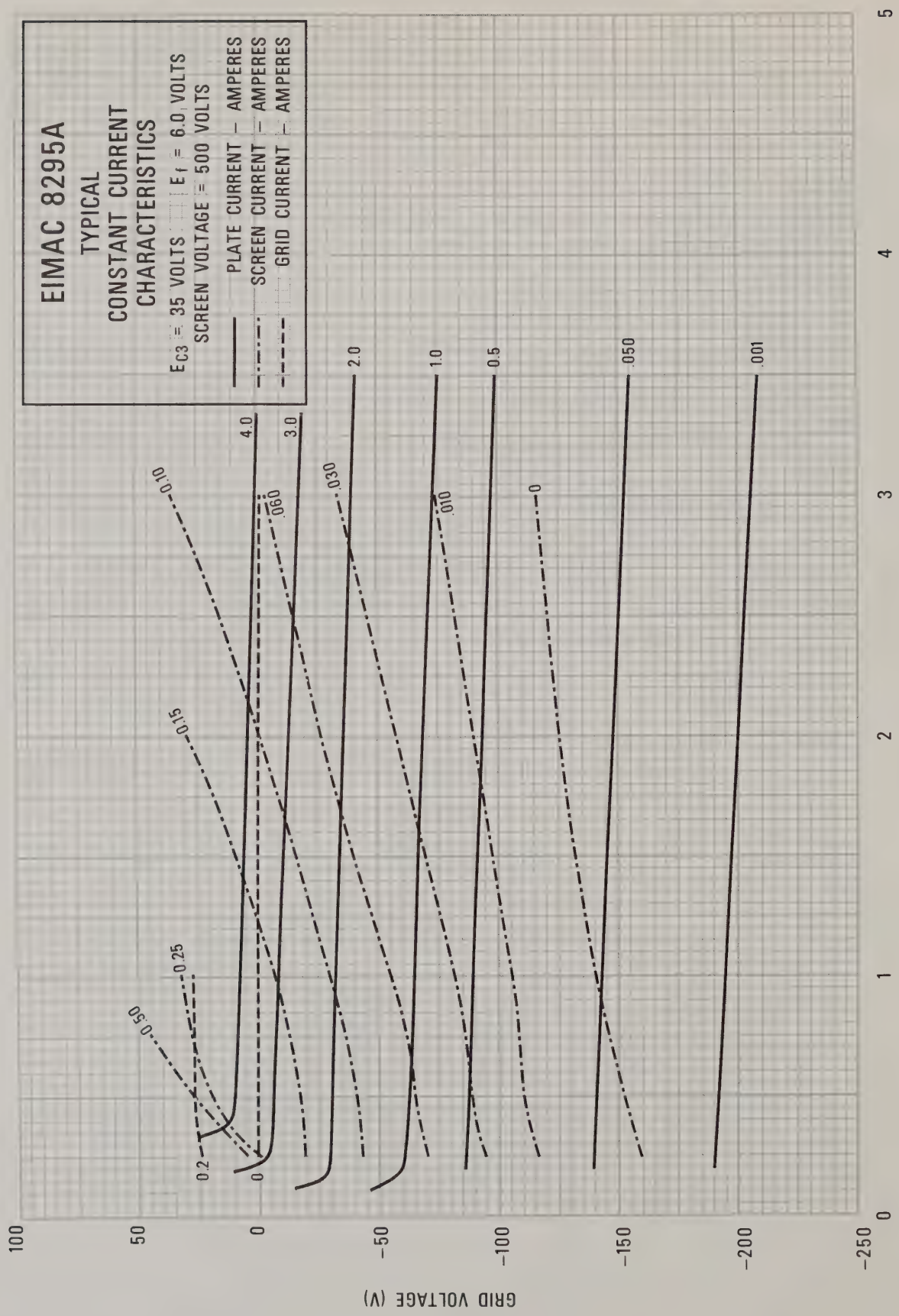


DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	3.458	3.832	87.83	97.33
B	3.968	4.032	100.79	102.41
C	3.485	3.515	88.52	89.28
E	1.615	1.630	41.02	41.40
F	.655	.719	16.64	18.26
G	1.395	1.645	35.43	41.78
H	1.468	1.532	37.29	38.91
J	.593	.657	15.06	16.69
K	1.056	1.219	26.82	30.96
L	.438	.562	11.13	14.27
M	.559	.573	14.20	14.55
N	.400	— —	10.16	— —
P	— —	.125	— —	3.18
T	.250	— —	6.35	— —
V	.220	— —	5.59	— —
W	.056	.062	1.42	1.57
X	.120	.127	3.05	3.23
REFERENCE DIMENSIONS				
D	51°			
Q	.125		3.18	
R	52°			
S	.125		3.18	
U	.250		6.35	
Y	1.000		25.40	



PIN CONNECTIONS	
PIN NO.	ELEMENT
1	k
2	g1
3	h
4	k
5	h
6	g1
7	k
CENTER PIN	INT. CON.
LOWER RING	g2
UPPER RING	g3
CAP	a


EIMAC 8295A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_{C3} = 0 VOLTS E_f = 6.0 VOLTS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT ⊢ AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT ⊢ AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE – (KV)
CURVE #3767
100
50
0
−50
−100
−150
−200
−250
0
1
2
3
4
5
0.2
0.50
0.15
0
0.10
0.60
4.0
3.0
0.30
2.0
1.0
0.10
0.5
0
0.50
.001


EIMAC 8295A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_{C3} = 35 VOLTS E_f = 6.0 VOLTS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
4.0
3.0
2.0
1.0
.5
.050
.001
.030
.010
0
.060
.10
.15
.25
.50
0.2
0
GRID VOLTAGE (V)
100
50
0
–50
–100
–150
–200
–250
0
1
2
3
4
5
PLATE VOLTAGE (KV)
CURVE #3770



pulse modulators

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.



other products

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.